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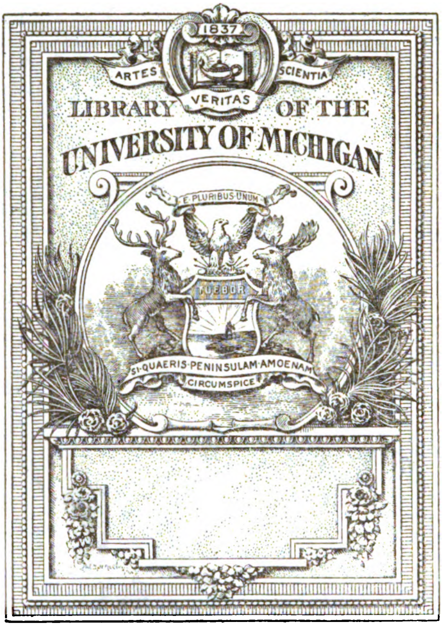
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MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY,

CONTAINING

PAPERS,

ABSTRACTS OF PAPERS,

AND

REPORTS OF THE PROCEEDINGS

OF

THE SOCIETY,

FROM NOVEMBER 1847, *TO JUNE* 1848.

WITH ONE SUPPLEMENT.

VOL. VIII.

BEING THE ANNUAL HALF-VOLUME OF THE MEMOIRS AND PROCEEDINGS
OF THE ROYAL ASTRONOMICAL SOCIETY.

LONDON:
PRINTED BY
GEORGE BARCLAY, CASTLE STREET, LEICESTER SQUARE.
1848.

The Council has directed that the present octavo half-volume shall be sold to Fellows for 2s. 6d., and to the Public for 5s.; and that it shall be presented gratis to all purchasers of the corresponding quarto half-volume, now in course of publication.

EXPLANATORY NOTICE.

The *Monthly Notices* of the Royal Astronomical Society have, of late years, greatly increased in bulk and importance. When the publication was committed to the present Editor, it was evident, that while a still greater extension was probable and desirable, the expense would be oppressive on the moderate funds of the Society.

A proposal was laid before the Council to the following effect:—That the *Notices* should be considered a portion of the *Memoirs*, and a substantive record of the proceedings of the Society, so that whatever had been printed in the *Notices* should be, except in special cases, held to be sufficiently published. From the difference in expense between the octavo and quarto forms, and by avoiding repetition, it was hoped that some saving might be made, although the *Notices* are given and the *Memoirs* sold; at any rate, it was certain that the Fellows would receive more information than before, and without additional payment. This proposal was approved of by the Council. The selection, compression, and arrangement of the matter, were left in a great degree to the discretion of the Editor, with very general directions as to the manner in which it was to be exercised.

It was further directed by the Council, that the *Monthly Notices* should be collected and published in an annual volume; that the quarto *Memoirs* should be published annually; and that unusual care should be taken to inform the possessors of either volume, that neither was complete without the other. The *Notices* and *Memoirs* are concurring series under different forms, containing between them all the proceedings of the Society.

The present volume is the *octavo half* of the new arrangement for the year 1847-8. The *quarto half* will probably appear about the time of the anniversary meeting in February next.

In arranging and condensing the matter of the *Notices*, the Editor has avoided as much as possible the exercise of any criticism. It has been his object to represent the views of each contributor in his own language, omitting, indeed, details which are unnecessary or not astronomical, but not varying the substance of the communication. Acquiescence with the suggestions brought under notice, is not to be implied from the silence of the Editor: he is merely answerable for arrangement and for ordinary care in passing the articles through the press. For the abstracts of the larger and more abstruse memoirs, (of those which are printed in the quarto half,) the Society have to thank the Astronomer Royal, Mr. Adams, Professor Challis, Mr. Main, &c. who have answered every request of the Editor to furnish these abstracts with readiness and punctuality.*

The principal object of the *Monthly Notices* is to assist in combining and regulating the work of British Astronomers, and to publish *original* and *authentic*

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* It is understood by the Fellows of this Society, that the Editor can call upon any one for help in cases where the subject-matter is beyond his reach, and that such calls must be obeyed, as indeed they always are.

information respecting the progress of Astronomy throughout the empire. A wish has been expressed that extracts should be made from the *Astronomische Nachrichten* and the *Comptes Rendus;* but, besides the increased expense, a compilation of this kind would scarcely be in accordance with the position and character of the Society. It is very seldom that any information is published by the Society which is not communicated by the author.

Some displeasure has been expressed by one or two Non-members that the *Notices* are not sold, separately, as they appear. They are, however, very widely distributed: to all Fellows who express a wish to have them, and to almost every gentleman who is known to have any acquaintance with astronomy, or even taste for it, who chooses to apply for them. It must be remembered that the Society, like all similar societies in England, is supported by the contributions of its Fellows, that any gentleman of character who *could* make any use of the *Notices may* become a Fellow, and that a sale of separate Numbers would give trouble, break sets, and produce no adequate advantage.

The observations of the present half-volume are, generally speaking, almost as good as can be expected in the present state of astronomy. Those of Cambridge, Markree, &c. exhibit not only the best *extempore* places which can be given, but the means of obtaining still better, when the places of the compared stars, or the approximate elements of the planet or comet, &c. are ascertained. They are also written out so clearly, that the MSS. can be put into the printer's hands with a short direction. In some of the earlier Numbers, nearly the whole notice required to be transcribed by the editor before it could be sent to press; and one or two contributors might still save a good deal of trouble and some risk of error, by transmitting a single copy of their observations, clearly written on one side of the paper, and in regular order. The originals of communications sent through a private hand, must in all cases be forwarded to the editor: copies must also be furnished when the originals are to be returned.

Inexperienced observers are requested to send their observations in the fullest detail, until the operations are familiar. It should be distinctly stated whether the observations are corrected or not, and how far the corrections extend: if there be any doubt, the naked observations should be sent at the same time, or at least a specimen.

The kindness of his Excellency the American Ambassador has opened a channel of communication with the United States, and the *Notices* can now be sent there to observatories and astronomers. On the other hand, the Astronomical Society will gladly make public the astronomical discoveries and remarkable observations of transatlantic astronomers, with whom they are almost identified by a common language and origin. The foundation and equipment of the American observatories (which possess some of the finest existing instruments, and most accomplished and zealous observers), their geographical positions, modes of publication, &c., are not known as they deserve to be.

With other countries, and for larger parcels, the communication is most unsatisfactory. The expenses and extra charges at the English ports are equivalent to a negative upon direct intercourse, even where the freight is prepaid, and the duty trifling. The Post-office charges for pamphlets over-sea are the same as for letters. Until these matters are better regulated, a greater service can scarcely be rendered to scientific bodies than by facilitating the rapid transfer of international communications at a moderate cost. Any information on this subject will be attended to.

ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *November* 12, 1847. No. 1.

Capt. W. H. Smyth, R.N., Vice-President, in the Chair.

The Rev. J. Slatter, M.A. of Rose Hill, near Oxford, was balloted for, and duly elected a Fellow of the Society.

FLORA.

Discovered at Mr. Bishop's Observatory, South Villa, Regent's Park, by Mr. Hind.

"On October 18, while comparing the excellent chart of Professor Knorre, hour iv. with the heavens, I discovered what seemed to be a star, ninth magnitude, near Bessel, v. 48, unmarked on the map; and from my acquaintance with this part of the heavens I had no hesitation in deciding upon its nature. A few hours' observation proved it to be a new planet, the eighth of the remarkable group between the orbits of *Mars* and *Jupiter*. Since the epoch of discovery, the brightness of the planet has considerably increased, and now equals that of a star of the eighth magnitude.

"At Mr. Bishop's request, Sir John Herschel has named the planet, *Flora*, with a flower," (*a rose?*) "for the symbol."

Observations.

Cambridge. (Professor Challis.)

1847.	Greenwich M. T.	R.A.	N.P.D	No. of Measures.	Reference Star.
	h m s	h m s	° ′ ″		
Oct. 19	9 51 50·3	5 3 49·48	75 57 23·1	1	Bessel, v. 48
20	9 57 58·9	3 58·80	58 28·7	10	——
21	11 59 44·2	4 5·95	59 35·4	8	——
	15 3 15·4	4 6·12	75 59 43·0	Meridian	
24	12 2 14·5	4 10·54	76 2 31·9	6	——
25	10 47 17·6	4 7·18	3 27·9	6	——
26	11 53 0·7	4 0·95	4 27·3	4	——
Nov. 1	11 5 0·3	2 33·04	9 25·8	4	——
	11 26 30·4	5 2 32·93	9 26·0	6	Bessel, v. 11
9	10 7 17·2	4 58 20·31	13 22·4	10	Bessel, iv. 1312
	13 43 25·7	58 13·11	13 28·4	Meridian	
10	13 38 47·4	4 57 30·61	76 13 40·3	——	

"The extra-meridional observations were taken with the Northumberland equatoreal. The following is the assumed mean place, Jan. 1, 1847, of Bessel, v. 48, as determined by two circle and four transit observations:—

R.A. = 5ʰ 3ᵐ 17ˢ·60   N.P.D. = 75° 49′ 45″·9.

The other two stars were taken from Weisse's Catalogue."

MARKREE. Large Equatoreal.* {E. J. Cooper, Esq. & Mr. Graham.

Greenwich M. T.	R.A.	Parallax.	Decl.	Parallax.	Obs.
	h m s	s	° ′ ″	″	
Oct. 27·493196	5 3 53·20	—[8·4960] *p*	+13 54 40·0	+[9·8444] *p*	16
Nov. 2·606546	2 5·72	—[7·4348]	49 45·7	+[9·8113]	11
5·481421	5 0 43·57	—[8·4590]	+13 48 7·0	+[9·8387]	10

The assumed apparent places of stars of comparison are

	h m s	° ′ ″	
Oct. 27	5 3 46·32	+13 44 2·2	Weisse's Bessel, v. 54
Nov. 2	5 1 39·79	+13 47 48·1	—— v. 11
5	5 0 41·93	+13 42 59·8	Lalande, 9671
	{5 1 39·21	+13 47 53·0	Lalande, 9714
	{5 1 39·86	48·0	Weisse's Bessel, v. 11

BERLIN. (Professor Encke.)

	Berlin M. T.	R. A.	Decl.	
1847.	h m s	° ′ ″	° ′ ″	
Oct. 24	10 6 4·6	76 2 47·85	+13 57 31·22	
	11 20 5·9	48·02	27·75	
	13 19 20·2	42·30	25·03	
	15 28 40·9	37·85	21·05	
25	14 3 6·1	76 1 47·2	+13 56 25·3	Doubtful.
	14 48 49·8	49·2	18·0	Merid. Obs.

ALTONA. Merid. Circle. {Prof. Schumacher & M. Petersen.

	Altona M. T.	R. A.	Decl.
1847.	h m s	° ′ ″	° ′ ″
Oct. 22	15 0 37·9	76 2 28·5	+13 59 17·8
25	14 48 46·8	1 33·9	56 20·3
26	14 44 44·7	76 0 0·0	55 24·7
31	14 23 56·7	75 42 50·3	+13 51 11·1

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* To obtain a large field with the Markree Equatoreal, Mr. Graham has applied a reticule, consisting of a square formed by four steel bars. This is adjusted by making a star traverse the diagonal. The occultations of the planet and compared stars by the bars furnished the data of the computed places. The stars of comparison were carefully selected before observing, a very necessary precaution.

The horizontal parallax, *p*, is expressed in seconds of space throughout the number.

HAMBURG. (M. Rümker.)

1847.	Hamburg M. T. h m s	R. A. ° ′ ″	Decl. ° ′ ″	No. Obs.
Oct. 22	11 13 47·4	76 2 21·2	+13 59 39·2	8
24	9 50 51·2	2 50·0	57 44·3	2
25	10 41 35·3	1 50·9	56 30·5	6
	14 48 46·3	1 31·2	56 19·1	Merid. Circle.
26	10 15 45·4	76 0 32·4	55 43·0	1
27	9 43 40·0	75 58 21·5	54 46·6	5
28	5 37·0	55 57·4	53 43·1	1
29	1 30·0	52 26·3	53 3·5	2
30	9 54 25·3	48 17·8	52 7·3	7
31	14 23 56·3	42 48·1	51 14·0	Merid. Circle.
Nov. 2	9 6 21·7	75 32 52·0	50 2·0	1
8	13 48 32·2	74 43 26·7	46 46·8	Merid. Circle.
9	43 56·5	33 28·7	46 32·0	—
10	39 18·7	22 58·4	46 21·7	—
12	13 29 56·8	74 0 22·2	+13 46 8·6	—

IRIS.

Observations.

MARKREE. Meridian Circle. { E. J. Cooper, Esq. & Mr. Graham.

Greenwich M. T.	R. A. h m s	Decl. ° ′ ″	Parallax.	
Aug. 21·435051	19 51 7·36	−13 42 29·2	+[9·9669] *p*	
Sept. 11·372296	43 34·03	14 15 16·94	[9·9684]	
29·326986	19 48 50·50	25 27·3	[9·9690]	Good
Oct. 19·284242	20 5 58·33	6 20·5	[9·9680]	
21·280346	20 8 13·83	−14 2 21·3	+[9·9678]	

Sept. 11 2d and 3d wires, badly taken; mere glimpses of planet.
Oct. 19 6 wires, not good; planet faint.
21 7 wires, not good; planet faint.

Equatoreal and Square-bar Micrometer.

Greenwich M. T. 1847.	R. A. h m s	Parallax.	Decl. ° ′ ″	Parallax.	No. Obs.
Aug. 19·515320	19 52 30·41	+[8·2555] *p*	−13 38 46·9	+[9·9573] *p*	10
27·460530	47 29·65	[8·0450]	53 8·9	[9·9650]	10
28·455677	46 59·91	[8·0281]	13 55 2·0	[9·9650]	24
Sept. 10·431816	43 35·51	[8·1474]	14 14 17·3	[9·9645]	38
13·437374	43 37·54	[8·1474]	17 37·1	[9·9645]	35
18·415734	44 22·79	[8·1843]	21 58·7	[9·9638]	14
Oct. 9·333986	19 56 6·32	[7·8683]	20 30·2	[9·9674]	6
15·397950	20 1 48·97	[8·3955]	13 6·7	[9·9539]	7
16·352440	2 48·16	[8·1875]	11 31·7	[9·9631]	10
20·361227	20 7 10·70	+[8·2827] *p*	−14 4 17·5	+[9·9598]	7

The log multipliers of the horizontal parallax will, when added to the log horizontal parallax, give the corrections in time and arc respectively.

Mr. Graham has appended the apparent places of all the stars of comparison, as deduced from Bessel's Zones, with the partial results where several stars have been used. Mr. Graham's reduced places exceed those of Weisse by 0ˢ·09, which must consequently be subtracted from the R.A. here given, to make them comparable with those of other observers who have followed Weisse. The planet has been compared each day the same number of times very nearly with the different stars. The references given below are to Weisse's *Catalogus Stellarum ex Zonis Regiomontanis*, Petropoli, 1846.

Aug. 19	xix.	1306	Sept. 18	xix.	1068, 1160, 1175
27		1182, 1187, 1200	Oct. 9		1319
28		1182	15	xx.	*a*, 81
Sept. 10		1068, 1160, 1175, 1187	16		*a*, 81
13		1068, 1073, 1160, 1175, 1187	20		81, 101

			h m s	° ′ ″	
Aug. 28	App. Place,	1182,	19 46 25·01	−13 56 25·3	Mer. Circle.
Oct. 15	——	*a*	20 2 58·66	−14 13 24·5	——

HAMBURG. Meridian Circle. (M. Rümker.)

1847.	Hamburg M.T.	R.A.	Decl.
	h m s	° ′ ″	° ′ ″
Sept. 24	7 34 25·5	296 35 7·5	−14 24 27·1
27	23 21·5	296 55 44·3	25 32·0
Oct. 3	4 1·8	297 50 17·0	24 38·4
4	7 0 48·9	298 1 1·2	24 5·8
10	6 42 2·7	299 13 32·7	19 39·6
11	39 0·7	299 27 2·6	18 36·4
14	30 3·7	300 9 51·8	14 51·1
15	27 7·8	300 24 54·3	13 20·3
16	6 24 13·1	300 40 15·2	14 11 38·9
25	5 59 4·5	303 14 19·4	13 53 15·8
26	56 23·3	303 33 0·9	50 45·1
28	51 4·0	304 11 18·6	45 7·8
29	48 24·4		42 11·4::
Nov. 2	38 7·5	305 52 17·7	13 29 35·7
10	18 19·6	308 47 37·4	12 58 36·8
12	5 13 53·0		−12 49 48·4::

Transit. (M. George Rümker.)

	Hamburg M.T.	R. A.		Hamburg M. T.	R. A.
	h m s	° ′ ″		h m s	° ″
Sept. 7	8 38 48·5	295 58 14·6	Sept. 16	8 3 29·3	295 59 18·7
10	26 43·5	53 46·9	27	7 23 21·5	296 55 50·3
13	14 57·1	54 18·7	Oct. 3	4 1·8	297 50 13·9
15	8 7 16·3	295 56 55·6	4	7 0 48·9	298 1 0·7

Ephemeris.

By M. d'Arrest, from his last Elements.

At 7 hours, Greenwich Mean Time.

1847.		R.A. Appt Eqx.			Hy Varn.	N.P.D.			Hy Varn.	Hor. Par.	Log r.
		h	m	s	s	°	′	″	″	″	
Nov.	12	20	38	22·30	+3·895	102	49	18·5	−11·43	4·3	0·31326
	13		39	56·22	3·932		44	40·6	11·73	4·3	31277
	14		41	31·05	3·969		39	55·7	12·02	4·2	31228
	15		43	6·73	4·004		35	3·8	12·31	4·2	31179
	16		44	43·23	4·038		30	4·8	12·61	4·2	31130
	17		46	20·55	4·072		24	58·7	12·90	4·2	31081
	18		47	58·67	4·105		19	45·5	13·19	4·2	31032
	19		49	37·60	4·138		14	25·3	13·49	4·2	30983
	20		51	17·29	4·170		8	58·1	13·78	4·1	30934
	21		52	57·77	4·202	102	3	23·8	14·08	4·1	30886
	22		54	38·99	4·232	101	57	42·4	14·37	4·1	30837
	23		56	20·91	4·262		51	53·9	14·67	4·1	30789
	24		58	3·56	4·291		45	58·2	14·97	4·1	30741
	25	20	59	46·89	4·320		39	55·5	15·26	4·0	30693
	26	21	1	30·91	4·349		33	45·8	15·55	4·0	30645
	27		3	15·62	4·377		27	28·9	15·85	4·0	30597
	28		5	0·99	4·404		21	4·9	16·15	4·0	30549
	29		6	47·01	4·431		14	33·8	16·44	4·0	30501
	30		8	33·67	4·457		7	55·8	16·73	4·0	30454
Dec.	1		10	20·96	4·483	101	1	10·6	17·03	4·0	30406
	2		12	8·87	4·509	100	54	18·5	17·32	3·9	30359
	3		13	57·38	4·534		47	19·2	17·62	3·9	30312
	4		15	46·52	4·559		40	12·9	17·91	3·9	30265
	5		17	36·24	4·584		32	59·5	18·21	3·9	30219
	6		19	26·56	4·609		25	38·9	18·51	3·9	30172
	7		21	17·45	4·633		18	11·2	18·81	3·9	30125
	8		23	8·93	4·656		10	36·3	19·11	3·9	30079
	9		25	0·96	4·679	100	2	54·2	19·41	3·8	30032
	10		26	53·54	4·703	99	55	4·7	19·73	3·8	29986
	11	21	28	46·68	+4·726	99	47	7·8	−20·03	3·8	0·29940

NEPTUNE.

Observations.

Professor Chevallier says, "The accompanying observations of *Neptune* have been made by Mr. R. A. Thompson, the observer at the Durham Observatory, and have been completely reduced.

"The meridian observations in right ascension, with the exception of those of Aug. 7 and Oct. 18, were well taken: the meridian observations in north polar distance have been made under unfavourable circumstances.

"The observations with the equatoreal were made with a telescope by Fraunhofer, of about eight feet focal length, and above six inches aperture, with a position wire-micrometer.

"Each comparison consists of one observation of difference of north polar distance, and of observations of two, or three, and, on Aug. 14, of four wires, for difference of right ascension.

"The star of comparison from Aug. 7 to Aug. 31, and on Sept. 2, was 38 *Aquarii.* On Sept. 1, 3, 4, the comparisons were made with 38 and 40 *Aquarii:* afterwards with 40 *Aquarii* only.

"The places of the stars of comparison have been computed from the British Association Catalogue, meridian observations of those stars having shewn that those positions are very nearly correct.

"All the observations are corrected for the effects of refraction and parallax, assuming the horizontal equatoreal parallax to be 0″·3; and the results are compared with Mr. Adams's ephemeris of *Neptune* given in the *Monthly Notices* of the Royal Astronomical Society."

DURHAM. Meridian. {Professor Chevallier & Mr. R. A. Thompson.

1847.	Greenwich M.T.	R.A.	Obs^d—Calc^d.	N.P.D.	Obs^d—Calc^d.	Remarks.
	h m s	h m s	s	° ′ ″	″	
July 22	14 13 49	22 8 19·78	—0·33	102 6 50·6	+5·8	
Aug. 7	13 9 25	6 49·18	1·52	15 13·5	—4·3	R.A. only on one wire; approximate.
13	12 45 13	6 13·47	0·30	18 46·7	+2·9	
19	12 21 2	5 36·18	0·29	22 10·1	—2·4	
Sept. 2	11 24 31	4 8·69	0·55			Just visible.
3	20 29	4 2·70	0·42	30 58·4	+7·8	
4	11 16 27	3 56·60	0·43	31 28·4	+4·4	
16	10 28 6	2 46·40	0·57	37 53·8	+6·4	
20	10 12 1	2 24·74	0·53	39 47·6	+2·4	
Oct. 8	8 59 52	1 2·11	0·52	47 7·4	—1·5	
18	8 20 0	0 29·01	1·04	50 3·1	+2·6	Not good; cloudy.
27	7 44 18	22 0 9·65	—0·79	102 51 42·0	+0·7	

Equatoreal.

1847.	Greenwich M.T.	R.A.	Obsd—Calcd.	N.P.D.	Obsd—Calcd.	No. of Compa.	Remarks.
	h m s	h m s	s	° ′ ″	″		
Aug. 7	11 26 57	22 .6 50·46	−0·27	102 15 16·7	+1·2	1	
9	12 15 33	38·21	0·25	16 23·8	−1·0	5	
13	11 23 40	13·83	0·30	18 43·8	+2·0	7	
14	10 18 42	6 7·94	0·28	19 12·8	−2·2	7	
19	13 19 45	5 35·77	0·44	22 11·9	−2·1	4	
23	14 16 32	10·45	0·41	24 35·1	−0·6	7	
24	9 23 18	5 5·42	0·42	25 2·1	−1·5	3	Faint; not good.
31	10 25 10	4 21·44	0·41	29 10·6	+3·3	7	Faint; not good.
Sept. 1	11 37 3	14·79	0·57	29 44·7	+1·6	6	
2	12 1 17	8·63	0·46	30 16·3	−1·4	2	Very faint; uncertain.
3	11 37 2	4 2·66	0·39	30 50·4	−0·5	11	
4	11 47 59	3 56·55	0·34	31 29·0	−0·8	9	
10	13 14 34	19·82	0·81	34 43·8	−0·1	5	
13	11 50 33	3 3·18	0·39	36 18·7	+1·6	7	
14	8 52 28	2 58·07	0·51	36 44·2	−0·1	8	
20	10 55 24	2 24·56	0·54	39 46·0	0·0	7	
28	8 35 49	1 44·97	0·44	43 19·6	−0·2	6	
Oct. 21	9 31 49			50 37·4	−3·2	4	
27	8 41 37	0 9·53	0·84	51 40·7	−1·0	6	
28	7 54 2	8·28	0·57	51 47·3	−2·0	6	Haze; Planet faint.
Nov. 2	5 38 44	22 0 1·60	1·32	52 18·8	0·0	2	Obs. incomplete in R.A.
9	7 34 12	21 59 58·92	−0·90	102 52 30·4	−0·1	8	

HAMBURG. Meridian Circle. (M. Rümker.)

1847.	Hamburg M.T.	R.A.	Decl.
	h m s	° ′ ″	° ′ ″
Sept. 26	9 41 44·9	330 28 32·6	−12 42 32·8
27	37 44·2	27 21·3	43 0·0
28	33 43·4	26 6·9	43 24·9
Oct. 3	13 41·5	20 31·4	45 27·5
4	9 9 41·7	330 19 31·7	−12 45 45·4

POONA. (Capt. Jacob, B.E.)

1847.	Poona M.T.	Planet—Star. R.A.	Planet—Star. Decl.	Star of Comparison.
	h m	m s	′ ″	
April 28	17 0	+2 56·6	+2 57	Weisse, xxii. 123
29	16 59	0 52·55	−1 13·7	—— 173
30	17 7	0 56·8	−0 53·7	—— 173
May 3	16 40	1 8·8	+0 6·0	—— 173
4	17 6	1 12·3	+0 24·2	—— 173
5	17 2	1 15·8	+0 41·7	—— 173
12	16 51	1 37·0	+2 27·2	—— 173
13	16 51	1 39·6	+2 38·8	—— 173
July 27	11 20	1 22·6	−5 25·1	—— 123
Aug. 15	10 11	0 14·6	+0 29·6	—— 105
17	10 53	+3 20·5	−2 22·7	38 *Aquarii.*

Longitude of Poona, 4h 55m 45s East.

LASSELL'S SATELLITE OF NEPTUNE.

Observations.

STARFIELD. (Mr. Lassell.)

Greenwich M.T.			
1846.			
Oct. 10		Satellite seen for the first time Position estimated 60° n.f.	
Nov. 11		—— 45 s.p.	
30		—— 45 s.p.	
Dec. 3		—— 50 n.f.	Distance 3 diameters
1847.			
July 7		—— 50 n.f.	
8		—— 60 n.f.	
22	13h 0m	—— 40 s.p.	—— 1¼ diameters
25	12 40	—— 45 n.f.	—— 3
26		—— 50 n.f.	
Aug. 1	11 24	—— 40 n.f.	—— 4
3	12 12	—— 70 s.p.	—— 2
7	10 30	—— 40 n.f.	—— 3
10	11 42	—— 40 s.p.	—— 2
14		No satellite visible.	
18	11 12	—— 45° n.f.	—— 3
31	9 30	—— 20 n.f.	—— 1
	11 30	—— 5 n.f.	scarcely 1
Sept. 2	12 6	—— 50 s.p.	
3		—— 5 or 10° s.p.	sc. 1 diam.
4	11 30	—— 30 or 40 n.f.	(very unfavourable)
6	9 0	—— a little n.f.	(very unfavourable)
8	11 6	measured 45°·6 s.p.	Dist. measured 15′67
9		estimated 10 n.p.	(unfavourable)
13		measured 60°·4 s.p.	Dist. measured 16′0
14		—— 41·78 s.p.	
28	8 30	—— 53·25 n.f.	—— 16·0
29	8 15	—— 37·05 n.f.	—— 13·4
Oct. 2	8 54	—— 24·63 s.p.	—— 10·7
10	10 42	—— 48·85 n.f.	
13	8 18	—— 44·78 s.p.	—— 16·40
14	7 48	—— 29·92 s.p.	—— 9·84
16	8 12	—— 47·09 n.f.	—— 18·20
21	7 30	—— 60·95 n.f.	
Nov. 1	8 0	Satellite scarcely visible; seen nearly north	
8	7 42	—— 55°·38 n.f.	Dist. measured 14′27
9	7 30	—— 42·61 n.f.	—— 13·82

"The above observations were made with the 20-feet equatoreal and position and distance micrometer; powers, 205, 323, and 400. There being no apparatus for illuminating the wires, sufficient light to see them was necessarily introduced into the field."

CAMBRIDGE, U.S. (Professor W. C. Bond.)

"1847, Oct. $25^d\ 7^h\ 45^m$. The satellite is south preceding the planet 40°. Distance, 15″·4. The latter is the mean of three observations, of which the extreme difference is 1″·4. The angle of position is liable to some uncertainty. Power, 300. The above were taken in bright moonlight.

"Oct. $27^d\ 7^h\ 30^m$. The satellite is north following 61° 30′. Distance, 13″·7. Powers, 300 and 1000. The power of 1000 seems to have the advantage in the distinctness with which the satellite is seen. The positions and distance are the mean of six determinations by two observers. Extreme difference of position, 1° 30′. Ditto of distance, 2″·7.

"Oct. $28^d\ 7^h\ 45^m$. Satellite is n.f. 43° 15′. Distance, 15″·0. Mean of nine observations, by two observers. Extreme difference of positions, 4°; ditto of distance, 1″·4. Powers, 400 and 1000. We have pretty strong evidence of the existence of another satellite, fainter and more distant from the primary than Lassell's.

"The above were obtained with the illuminated wires of the micrometer of the 23-foot refractor; aperture, 15 inches.* The object is one of extreme difficulty to measure with precision."

MISS MITCHELL'S COMET.

This comet was seen in America, on October 1, by Miss Maria Mitchell, of Nantucket,† and was observed at the Observatory of Cambridge, U. S. October 7. It was seen October 3, at Rome, by Father De Vico; October 7, by Mr. Dawes, with the naked eye, at Cranbrook; and October 11, by Mrs. Rümker, at Hamburg.

Mr. Dawes says that, on October 7, he remarked it "as a hazy star of the fifth magnitude, near ω *Draconis*. Examination with the 8½-foot refractor proved it to be a large comet, its rapid motion being speedily detected. On the 11th, it had the light of a star of the fourth magnitude, near η *Herculis*. The nebulosity in the telescope extended over 30′, nearly round, much condensed in the centre, but without stellar nucleus. A star of the tenth magnitude (Herschel's fourteenth) was distinctly seen through the exact centre of the comet."

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* The Cambridge U.S. equatoreal is $22^f\ 8^i$ focal length, and 15 inches aperture: it is by the same artist, of the same size, and upon the same construction, as the equatoreal of Poulkova. It stands on a very massive pier, which is insulated. The covering dome is 30 feet in diameter, revolving on eight cannon balls. An observing chair, of a novel construction, gives the observer complete command over his position. When the eye-piece is properly adjusted, there is no colour, except a purple tinge round very bright objects, such as *Venus* or the moon.

The telescope readily separates such stars as γ *Coronæ*, γ^2 *Andromedæ*, and Struve's "Vicinissimæ." The nebula, 27 *Messier* in *Vulpecula*, and the great nebula in *Orion*, are resolved into bright stars; the latter in the vicinity of the trapezium. There is no appearance of a ring to *Neptune* when viewed with high powers, though with lower powers there seems to be an elongation.

† This information comes from Professor W. C. Bond, of the Cambridge Observatory, U. S.

CRANBROOK. 8½-foot Equatoreal. (Rev. W. R. Dawes.)

	Greenwich M. T.	R. A.	Parallax.	N. P. D.	Parallax.	
1847.	h m s	° ′ ″	″	° ′ ″	″	
Oct. 7	11 20 4	257 59 43·6	+1·767*p*			Argelander's Zones, 126, Nr. 63
	11 46 41			19 43 46·9	−0·512*p*	
8	7 29 37	254 38 39·7	+1·158*p*			A. Z. 123, Nr. 78
	7 40 48			25 21 13·2	−0·022*p*	
	8 14 36	254 31 27·6	+1·336*p*	25 31 44·2	−0·109*p*	A. Z. 123, Nr. 81
11	8 9 8			*a* +7 26·3	−0·500*p*	
	8 35 11	*a* −13 52·5	+0·774*p*			
	9 51 31	248 9 50·4	+0·782*p*			Lalande, 30327
	10 24 19			52 22 24·0	−0·737*p*	
13	7 21 40			*b* +16 24·4	−0·648*p*	
	7 36 10	*b* +7 0·0	+0·615*p*			
	8 22 14	246 5 26·6	+0·663*p*			Rümker, 5434
	8 23 1			70 22 41·1	−0·701*p*	
15	7 6 53	244 36 27·9	+0·579*p*			Rümker, 5418
	7 21 6			86 0 17·9	−0·759*p*	
17	7 9 50	243 24 48·6	+0·583*p*	97 56 12·8	−0·804*p*	*υ* Ophiuchi

The apparent places of the stars of comparison are computed from the authorities quoted. The approximate places of *a* and *b* are

	Mag.	R. A.	N. P. D.
		h m s	° ′ ″
a	7½	16 33 51	51 20 49
b	8	16 24 1	69 43 49

"The comparison in north polar distance on the 15th was made with the declination circle, the distance being too great to be measured, as the others were, by the wire-micrometer."

VIENNA. (MM. Littrow & Schaub.)

	Vienna M. T.	R. A.	Parallax.	Decl.	Parallax.
	h m s	h m s	s	° ′ ″	″
Oct. 12	7 43 8·5	16 28 33·45	+0·0478*p*	+29 32 54·1	+0·5720*p*
14	8 47 23·4	21 11·84	0·0453	+11 23 28·1	0·7293
16	7 7 53·5	16 16 1·88	+0·0517	− 2 9 4·2	+0·7547

CAMBRIDGE, U. S. (Professor W. C. Bond.)

	Cambridge M. T.	R. A.	Decl.	No. Obs.	Star of Comparison.
1847.	h m s	h m s	° ′ ″		
Oct. 7	7 56 31	17 10 56·2	+70 1 18	2	*ζ Draconis*
9	6 48 11	16 44 14·4	55 31 51	1	Arg. Z. 13, Nr. 48
11	8 9 11	32 0·2	36 38 7	4	Lalande, 30500
14	7 42 54	20 34·7	9 51 17	3	Bessel, xvi. 466
15	7 27 27	17 59	+ 2 36 13	2	—— 367?
18	6 34 44	16 11 10·1	−13 18 49	4	—— 173

The apparent places of the stars have been derived directly from the *Hist. Cél.* and from Bessel's Zones. The *nomenclature* here given is from the recent reductions of those works. "From the 7th to the 14th inclusive, the observations were made with the large equatoreal (*see note*, p. 9), using the declination circle for comparing with the star. On the 15th, the 5-foot equatoreal was employed, using Troughton's micrometer with red light. On the 18th, the annular micrometer was used with the 5-foot equatoreal. The comet visible to the naked eye all the time."

Elements.

By M. d'Arrest.

T ... 1847, Nov. 14·44201, Berlin M.T.

	° ′ ″	
ϖ	274 14 1.1	Mean Equinox, Jan. 0, 1847.
☊	190 50 12·7	
i	71 53 6·4	
Log *q*	9·5174122	Motion Retrograde.

By Mr. G. P. Bond.

Per. Pass. Nov. 14·6935, Cambridge, U.S. M.T.

	° ′	
Long. Per.	276 24	
Node............	191 1	
Inclination	72 28	
Perihelion Distance...	0·3468	Motion Retrograde.

The comet may possibly be seen again at the end of the year; to facilitate the search, M. d'Arrest has computed the following

Ephemeris.

		R.A.	Decl.	Log Δ.
		° ′	° ′	
1847.	Dec. 10	227 33	−9 45	0·1519
	15	228 51	5 37	0·1541
	20	230 8	−1 31	0·1547

MAUVAIS' THIRD COMET.

Observations. By Mr. W. W. Boreham, at Haverhill.

1847.	Greenwich M.T. h m s	R.A. h m s	Decl. ° ′ ″	No. Obs.
July 30	10 16 31·7	13 8 23·57	+72 16 33·3	3
Aug. 6	10 31 56·1	12 58 19·83	66 25 43·5	4
7	9 40 5·4	12 57 42·53	65 38 41·8	3
14	9 36 6·9	12 54 31·94	+60 24 16·9	2

COLLA'S COMET.

VIENNA. (MM. Littrow & Hornstein.)

	Vienna M.T.	R.A.	Parallax.	Decl.	Parallax.
	h m s	h m s	s	° ′ ″	″
Sept. 10	10 2 40·8	12 34 48·00	+0·0579 *p*	+54 47 25·3	+0·7888 *p*
13	8 29 49·1	12 43 0·81	0·0736	55 9 20·9	0·6028
Oct. 11	9 8 18·7	14 17 37·65	+0·0716	+58 25 38·3	+0·6950

Elements.

By M. Littrow.

Perihelion Passage, 1847, June 4·79225, Berlin M.T.

	° ′ ″	
Longitude Perihelion	206 18 28·9	M. Eq. 1847·0.
Ascending Node	173 56 4·3	
Inclination	100 25 52·7	
Log. Per. Distance	0·3255424	

Computed from observations on May 16, July 16, and Sept. 13.

Ephemeris.

1847.	R.A.	N.P.D.	Log *r*.	Log. Δ.
	° ′	° ′		
Nov. 22	261 2·8	30 58·7	0·4592	0·4556
26	265 34·3	31 20·5	0·4636	0·4590
30	269 59·1	31 46·2	0·4681	0·4629
Dec. 4	274 16·4	32 15·0	0·4726	0·4673
8	278 24·9	32 46·7	0·4770	0·4722
12	282 24·4	33 20·4	0·4814	0·4776
16	286 14·3	33 55·5	0·4858	0·4833
20	289 54·4	34 31·6	0·4902	0·4894
24	293 24·8	35 8·0	0·4945	0·4959
28	296 45·8	35 44·3	0·4989	0·5027
32	299 57·7	36 20·1	0·5032	0·5097

SCHWEIZER'S COMET.

HAMBURG. (M. Rümker.)

1847.	Hamburg M. T.	R. A.	Decl.
	h m s	° ′ ″	° ′ ″
Sept. 27	8 46 55·1	294 50 3·6	+38 56 16·7
28	8 46 8·4	293 58 26·2	37 20 57·8
Oct. 2	9 25 5·0	291 12 33·8	31 26 38·4
4	8 48 58·0	290 10 59·5	+28 50 3·6

Elements. By Mr. N. Pogson.

Perihelion Passage, 1847, August 9·46479, Greenwich M.T.

	° ′ ″	
Longitude Perihelion	21 12 37·5	Mean Eq. Sept. 0, 1847.
Ascending Node	76 48 28·3	
Inclination	32 38 26·7	
Log. Least Distance	0·1718329	Motion Retrograde.

"Computed from observations on September 11, 19, and 27.

ANNULAR ECLIPSE OF OCT. 9, 1847.

The Astronomer Royal stated the substance of two letters respecting the solar eclipse of October 9, 1847; one, from M. Mauvais addressed to himself, and the other from M. Schaub, communicated by M. Le Verrier to Mr. Hind.

The *Bureau des Longitudes* assigned to MM. Mauvais and Goujon the station of Orleans, near the southern limit of the places where the eclipse was annular. Their attention was especially directed to those phenomena which are described by Mr. Baily in the tenth volume of the *Memoirs*.

The position of Orleans was particularly favourable for observing the appearances which present themselves at contact. "When the cusps of the sun were about a quarter of the moon's diameter apart, the advance of these points towards each other was very sensible, being almost as rapid as the movement of a star in the field of a transit instrument, but it was not uniform. The cusps appeared to wriggle forwards, sometimes faster, sometimes slower, with a *vermicular* motion."

"I saw distinctly," M. Mauvais says, "a luminous trace in advance of the cusp and in its prolongation, but at a distance of about 10″ the dark interval gradually diminished in extent at its extremities, and the detached luminous points grew larger and finally fused in one. Just before the definitive formation of the annulus, a series of points and luminous traces, more or less extended in the direction of the moon's limb (but all very thin in the perpendicular direction), were seen throughout the space between the cusps; all these grew gradually larger at the extremities, and finally united. The ring, when formed, was very thin, not exceeding a few seconds. I insist particularly on this point, that the dark intervals gradually decreased, not merely in a direction parallel to the moon's limb, but also in depth or perpendicular to the limb. They did not extend themselves into dark filaments, as described by Mr. Baily, in his *Memoir*, and as represented in his drawing."

"The appearances agree with Mr. Henderson's description (p. 39). There was nothing seen at Orleans which required for its explanation a phenomenon of *diffraction* or of *irradiation:* every thing seems accounted for by the irregularity of the moon's edge, the tops of the mountains having reached the limb of the sun, while a few rays escaped through the valleys."

M. Schaub observed at Cilly, in Styria. Latitude, 46° 13′ 20″ N. and 12° 55′ 25″ East of Paris. "With a magnifying power of 40 and a red shade, the formation of the ring took place without any irregularity. At this time the sun was a little clouded, but shortly after he became perfectly clear; and a power of 60 was applied, with a dark glass, which, combining complementary colours, gives white images. The lunar mountains were distinctly seen upon the sun. The limb of the moon undulated, but continued circular up to the time of the second contact. This contact did not take place in a continuous line; the tops of several mountains touched

the sun's limb at once, so that the cusps were connected by a series of luminous points separated from each other, but perfectly referable to the forms of the mountain previously seen."

"Of all the phenomena described by Mr. Baily (*Mem. R. A. S.* vol. x.), I only saw those represented in fig. 1; but to make this agree with my observation, the serrated portion should be diminished one-half.

"The duration of the annulus was $7^m\ 0^s{\cdot}4$, which should, perhaps, be increased 2^s or 3^s, on account of the clouds at the first contact. The second contact was estimated to take place at the disappearance of the luminous points. If the second contact be estimated from the formation of these points, then the duration must be shortened about 1^s."

SOLAR SPOTS.

Extract of a letter from Mr. J. H. Griesbach, to the President.

"I have great pleasure in sending you copies of a series of my drawings of the solar spots, from September 20th, to October 25th, 1843, complete, with the exception of one day; and I shall be happy to copy all the others, if you will let me know how you like them to be done. The telescope I use is a 6-foot Newtonian, the speculum 6 inches diameter. The position of the spots I often determine by receiving the image on a drawing-board: some of the drawings were made only from the view, but I have been careful to represent the changes in the form and nature of the spots, thinking that an extended series of drawings may in the end afford some indication of the nature of their cause. On the 27th of September, 1843, I made hourly drawings of the sun, and between four and five o'clock, three fresh spots broke out, two near the centre of the disc; they were not visible the following day. The changes in the form of the large spot which came into view on the 14th of October, 1843, are particularly interesting."

Mr. Griesbach's drawings were presented to the Society, with a drawing made on September 27, 1843, of *Jupiter, seen without his moons.* This rare phenomenon was also observed at Woodstock, Vermont, U. S.

Extract of a letter from the President, enclosing Mr. Griesbach's Communication.

"Herewith I enclose a letter from Mr. H. Griesbach, explanatory of the drawings of the solar spots, which I lately addressed to you, executed by him, and which, at my request, he has been good enough to copy for communication to the Astronomical Society, as a contribution to the history of the solar spots, and as the *commencement of a collection of such drawings*, which it appears to me highly desirable should be formed, with a view to securing, if possible, an unbroken series of such drawings, exhibiting a continuous view of the changes in the sun's surface for every day in every

year in future, and as near an approach to it in past years as can now be recovered. It seems high time that some attempt of the kind should be made on a systematic and regular plan, as the only probably effectual means of arriving at a knowledge of the laws which govern these mysterious phenomena, and the periods, if any, which they observe in their formation, and thence of elucidating the nature of the sun itself.

"No single observer, at a fixed locality, can, of course, with any amount of diligence, contribute more than a very fragmentary series of such observations; nor, considering the frequency of long-continued runs of cloudy weather extending over immense tracts of country, could even the united observations of all Europe avail to secure such a continuous series as there is a necessity of obtaining. If, however, it were to be made known to observers in every region of the globe, that a permanent establishment, such as the Astronomical Society, interested itself in the formation of such a collection, and had opened a ***department in its archives for the reception and arrangement of such contributions from all quarters***, there can be little doubt that many individuals, resident in climates habitually serene, would be induced to make and contribute diurnal representations of the solar disc.

"Should the Astronomical Society think proper to issue any prospectus or notice, calling for such contributions, it would, of course, be desirable that the plan should be cast so as to secure a certain degree of uniformity in their execution, both as respects the hour or hours of the day, ***when***, and the scale ***on which***, they should be made. If made, for instance, at, or as nearly as possible at, noon, observations made on the same day in Europe, India, Australia, and America, would, in effect, furnish not merely a diurnal but a quarto-diurnal series, adding much to the interest of the whole. Moreover, the exceeding facility with which photographic processes are executed, and especially the short time which the *Talbotype* process occupies, makes their execution on a given scale, and with every requisite degree of precision, easily attainable.

"In the hope that such a collection may be set on foot, it is my intention, so soon as I can find leisure, to execute, and offer to the Society, a series of copies on a uniform scale, corresponding to Mr. Griesbach's (that is to say, in which the disc of the sun shall be represented by a circle $3\frac{1}{2}$ inches in diameter), of all the drawings I possess of the solar spots."

Eclipse of the Sun, April 15, 1847.

Capt. P. P. King, R.N. observed the beginning of this eclipse at Tahlee, Port Stephens, New South Wales, at $4^h\ 36^m\ 36^s{\cdot}8$, mean time at the place.

"Magnitude of eclipse (proportion of observed part to whole disk) 0·616 on northern limb.

Latitude, S....... 32° 40′ Longitude, E....... $10^h\ 8^m\ 8^s$

The longitude is computed from this eclipse by the data of the *Nautical Almanac:* Mr. Woolhouse's method."

M. d'Arrest finds, from a comparison of the places of ε *Indi* in the catalogues of Lacaille, Brisbane, and Taylor, that this star has a remarkable proper motion.

		R.A.	Decl.
		″	″
From 1750	to 1825	+ 6·02	−2·36
1825	1835	+13·21	−3·05

Professor Chevallier presented a working model of a machine for giving the time at places which are in sight of each other. A ball is let drop, as at Greenwich, Liverpool, &c.; but the motion is retarded and made nearly uniform by connecting it with a fly-wheel. There are horizontal rings attached to the staff at different heights, through which the ball drops; and the observer, being prepared, can estimate very nicely the moment at which upper and lower surfaces of the ball pass these rings.

Sweeping Ephemeris for the expected Comet of 1264 *and* 1556.
From Mr. Hind's Tables in the *Monthly Notice* for April 1847.

	P. P. Jan. 11.		P. P. Feb. 10.		P. P. March 11.	
	R.A.	N.P.D.	R.A.	N.P.D.	R.A.	N.P.D.
1847.	h m	° ′	h m	° ′	h m	° ′
Nov. 22	13 38	100 13	12 37	100 17		
Dec. 2	14 24	101 44	13 7	101 42		
12	15 20	102 56	13 43	103 15	12 37	102 56
22	16 28	103 32	14 28	104 36	13 4	104 30
32	17 46	103 17	15 23	105 25	13 37	105 58

Mr. Cooper states that a star in Bessel's Zone 185, Weisse xx. 122, is not to be found in the heavens.

Capt. Jacob, at Poona, saw the companion of ν *Scorpii* double. The following measures were taken with a 5 foot telescope, power 152.

	Position.	Weight.	Distance.	Weight.
	°		″	
AB	336·4	41	40·53	25
BC	43·2	21	1·75	

The distance of BC is estimated: B = 7 mag., C = 8 mag.

The Astronomer Royal gave a brief account of the Observatory of Poulkova, which he has lately visited, and explained the nature of M. Struve's views on the *Milky Way* and the distance of the Fixed Stars, as set forth in his recent publication, *Etudes d'Astronomie Stellaire*, St. Petersburg, 1847. An abstract of this will probably appear in the ensuing *Notice*.

ERRATUM.

Vol. vii. p. 307, *for* sixth satellite of *Saturn*, *read* the most distant satellite.

Printed by George Barclay, Castle Street, Leicester Square.

ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *December* 10, 1847. No. 2.

Capt. W. H. Smyth, R.N., Vice-President, in the Chair.

Capt. F. Blackwood, R.N. of the Senior United Service Club, Pall Mall, was balloted for, and duly elected a Fellow of the Society.

FLORA.

Observations.

South Villa. Equatoreal. (M.M. Bishop & Hind.)

1847.	Greenwich M. T. h m s	R. A. h m s	N.P.D. ° ′ ″
Oct. 18	11 40 4	5 3 39·23	75 56 28·2
	15 4 10	40·63	37·4
	15 52 27	41·09	38·3

These are the *first* Observations of *Flora*, the evening she was discovered. They were omitted by oversight in the last Notice.

Cambridge. (Professor Challis.)

1847.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Comp. R.A.	N.P.D.	Star of Reference.
Nov. 15	11 53 15·4	4 53 33·46	76 13 32·9	4	4	B.A.C. 1542
	55 55·6	33·15	30·6	10	7	*a*
16	13 10 18·6	52 36·50	13 15·6	Meridian		
17	13 5 27·7	51 41·34	12 54·3	—		
18	13 0 35·5	50 44·90		—		
19	12 55 41·4	4 49 46·54	76 11 54·3	—		

"The equatoreal observations were taken with the Northumberland telescope. No correction is applied for parallax. The place of *a* was determined by two transit and two circle observations as follows:"—

1847
Nov. 15 Apparent R.A. = 4h 53m 46s·34 App. N.P.D. = 76° 18′ 45″·9

Elements.

By Mr. Hind.

"Six weeks' observations of *Flora* have sufficed for the determination of an orbit which I think will not require any material correction. From our observations of October 18, November 9, and December 5, I have calculated the following elements, taking account of all the small corrections, and employing the general method of Gauss, with some slight modifications for adaptation to this particular instance. The orbit is almost identical with that deduced by M. d'Arrest from the Berlin Meridian Observations up to November 17.

Epoch, 1848, January 0·0, Mean Time at Greenwich.

	°	′	″	
Mean Anomaly	35	39	1·87	
Longitude of Perihelion on the Orbit	32	48	44·95	M. Eq. 1848·0
Ascending Node	110	19	6·21	
Inclination	5	52	47·76	
Angle of Eccentricity	9	1	26·10	
Log. Semi-axis Major	0·3426076			
Mean Sidereal Daily Motion	1086″·66375			

"These elements represent the middle observation with an error of + 0″·9 in longitude and — 0″·1 in latitude.

"It appears, therefore, that the period of revolution of *Flora* (about 3¼ years), is considerably shorter than that of any other small planet. It is also less than that of Encke's Comet, which has hitherto taken the lead after *Mars*. The position of her orbit is favourable to Olbers' well-known idea with regard to the origin of this zone of planets, an hypothesis which is also countenanced by the elements of *Hebe* and *Astræa*.

"According to the latest and most accurate determinations of their elements, it appears probable that the small planets now have the following order with respect to mean distance from the sun:— *Flora*, *Iris*, *Vesta*, *Hebe*, *Astræa*, *Juno*, *Ceres*, *Pallas*.

"*Iris*, *Vesta*, and again *Ceres*, *Pallas*, are so close upon each other, that the effects of perturbations may alter their relation in order of mean distance. It will be remarked that the inclinations of three of the orbits of the newly discovered planets, viz. those of *Astræa*, *Iris*, and *Flora*, are nearly the same."

By M. d'Arrest.

1847, October 18, at 12^h M.T. at Berlin.

	°	′	″	
M	13	44	26·94	
ϖ	32	18	34·63	M. Eq. 1847·0
☊	110	23	2·42	
i	5	52	21·74	
φ	9	8	38·15	
μ	1084″·0800			
Log *a*	0·3433161			

From the Berlin Meridian Observations of Oct. 22, Nov. 2, and Nov. 17.

Ephemeris. For Greenwich Mean Midnight.

By Mr. Hind.

	R.A.	N.P.D.		R.A.	N.P.D.
1847.	m s	° ′ ″	1848.	h m s	° ′ ″
Dec. 9	4 28 8·3	75 39 32	Jan. 5	4 9 59·2	73 49 17
10	27 5·6	36 47	6	9 49·1	43 58
11	26 4·0	33 56	7	9 41·4	38 35
12	25 3·6	30 58	8	9 36·1	33 8
13	24 4·4	27 52	9	9 33·2	27 37
14	23 6·6	24 41	10	9 32·6	22 2
15	22 10·3	21 22	11	9 34·4	16 24
16	21 15·6	17 57	12	9 38·5	10 42
17	20 22·5	14 25	13	9 45·0	73 4 57
18	19 31·1	10 48	14	9 53·7	72 59 9
19	18 41·5	7 4	15	10 4·7	53 18
20	17 53·8	75 3 14	16	10 18·0	47 25
21	17 8·0	74 59 18	17	10 33·5	41 29
22	16 24·1	55 16	18	10 51·2	35 31
23	15 42·3	51 9	19	11 11·1	29 31
24	15 2·6	46 55	20	11 33·2	23 29
25	14 24·9	42 36	21	11 57·4	17 25
26	13 49·4	38 11	22	12 23·7	11 20
27	13 16·1	33 40	23	12 52·1	72 5 13
28	12 45·0	29 4	24	13 22·5	71 59 5
29	12 16·1	24 23	25	13 54·9	52 55
30	11 49·5	19 37	26	14 29·4	46 45
31	11 25·3	14 45	27	15 5·8	40 34
1848. Jan. 1	11 3·4	9 49	28	15 44·1	34 22
2	10 43·8	74 4 48	29	16 24·3	28 10
3	10 26·6	73 59 42	30	17 6·5	21 57
4	4 10 11·7	73 54 32	31	17 50·5	15 44
			Feb. 1	4 18 36·3	71 9 30

The ephemeris gives the position of *Flora* referred to the true equinox. The aberration has not been applied, but the correction due to aberration is subjoined below for every fourth day, with the value of $497^{s}{\cdot}8 \times \Delta$ and the horizontal parallax.

	Corr. for Ab. R.A.	Corr. for Ab. N.P.D.	$497^{s}{\cdot}8 \times \Delta$	Hor. Par.		Corr. for Ab. R.A.	Corr. for Ab. N.P.D.	$497^{s}{\cdot}8 \times \Delta$	Hor. Par.
1847.	s	″	″	″	1848.	s	″	″	″
Dec. 11	+0·33	+1·0	472·1	9·05	Jan. 8	+0·03	+2·1	561·8	7·61
15	·31	1·1	480·0	8·91	12	−0·04	2·3	580·2	7·37
19	·28	1·3	489·6	8·73	16	·10	2·5	599·7	7·13
23	·24	1·5	501·0	8·53	20	·17	2·6	620·2	6·88
27	·19	1·6	514·0	8·31	24	·23	2·7	641·5	6·66
31	·14	1·8	528·5	8·09	28	·30	2·9	663·6	6·44
1848. Jan. 4	+0·08	+2·0	544·5	7·85	Feb. 1	−0·36	+3·0	686·3	6·23

HEBE.

Observations.

Cambridge. Northumberland Equatoreal. (Prof. Challis.)

1847.	Greenwich M.T.	R.A.	N.P.D.	No. of Comp. R.A.	No. of Comp. N.P.D.	Star of Reference.
	h m s	h m s	° ′ ″			
Sept. 22	8 1 49·3	17 26 40·08	105 9 14·6	9	9	B.A.C. 5949
25	7 33 32·6	30 22·23	31 31·9	10	10	— 5948
27	7 51 55·8	17 32 58·34	105 46 9·9	10	10	— 5984
Oct. 20	6 38 55·6	18 7 23·62	108 6 24·7	6	6	H.C. 33588
21	6 51 42·4	9 5·13	108 11 19·0	7	4	— —
Nov. 2	5 59 3·4	30 9·66	109 1 12·5	8	8	B.A.C. 6333
10	5 45 1·0	18 45 9·81	25 10·6	1	1	— 6376
18	5 34 44·1	19 0 49·41	40 58·1	10	10	— 6536
19	5 27 34·9	2 48·56	42 20·4	6	6	— —
23	5 21 56·1	10 52·48	46 38·5	5	5	B.A.C. 6616
	24 24·4	10 53·06	46 36·9	3	3	— 6584
24	5 21 19·5	12 54·78	47 27·0	8	6	— 6616
29	5 49 41·1	19 23 15·76	109 49 9·2	5	2	H.C. 36857

"The observations have been corrected for refraction, but not for parallax. The places of the stars are adopted from the catalogues cited, regard being paid to secular variations."

Makerstoun. Equatoreal. (Sir T. M. Brisbane.)

1847.	Makerstoun M.T.	R.A.	N.P.D.	No. Obs.	Star of Comparison.
	h m s	h m s	° ′ ″		
July 14	10 59 44	17 1 3·83		14	Weisse, xvi. 1158
	11 13 2		95 9 12·9	11	—— —
17	11 3 34	16 59 26·32	31 21·4	10	*a*
20	11 25 1	57 58·60	95 55 14·0	1	B.A.C. 5688
26	10 47 31	55 54·47	96 44 34·4	10	Weisse, xvi. 1004
31	9 55 4	54 58·22	97 27 29·3	6	—— 1067
Aug. 2	9 36 11	54 47·92	45 2·0	7	—— 975
3	9 33 27	54 45·18	97 53 56·8	5	—— —
7	9 52 38	54 52·82	98 29 58·8	3	*b*
10	9 58 58	55 15·66	98 57 21·2	10	Weisse, xvi. 1048
13	9 14 42	55 54·29	99 24 51·2	9	*c*
18	9 18 32	57 34·39	100 10 21·4	10	Weisse, xvii. 3
19	8 58 38	16 57 59·01	100 19 23·9	10	—— —

"The mean places of stars *a*, *b*, and *c*, for 1847·0, are assumed to be

	Mag.	h m s	° ′ ″
a	8·9	16 56 49·00	95 22 40
b	8	50 36·00	98 22 50
c	8	16 56 56·00	99 25 10

and the corresponding places of the planet are computed on this assumption."

IRIS.

Observations.

CAMBRIDGE. (Professor Challis.)

1847.	Greenwich M.T.	R.A.	N.P.D.	No. of Comp. R.A.	No. of Comp. N.P.D.	Star.
	h m s	h m s	° ′ ″			
Sept. 10	10 16 40·3	19 43 35·49	104 14 9·6	8	8	Bessel, xix. 1068
11	10 34 35·9	43 34·11	15 13·8	6	6	—— —
14	8 10 35·9	43 41·73	18 23·1	Meridian		
17	10 31 5·0	44 9·20	21 12·2	6	6	Bessel, xix. 1068
18	7 55 4·6		21 48·7	Meridian		
22	40 58·5	45 31·85	24 1·4	—		
24	33 53·6	46 18·88	24 55·6	—		
25	30 24·1	46 45·33	25 7·2	—		
27	7 23 29·5	47 42·77	25 26·5	—		
Oct. 7	6 50 49·2	54 22·58	22 10·9	—		
12	35 31·7	58 45·34	17 19·4	—		
13	32 33·6	19 59 43·35	16 1·7	—		
19	15 10·1	20 5 56·29	6 27·0	—		(N.P.D. uncertain.)
20	12 20·7	7 2·95	4 27·5	—		
21	6 9 33·5	8 11·89	104 2 22·0	—		
25	5 58 36·6	12 59·37	103 47 43·7	—		
26	5 55 55·3	14 14·19		—		
Nov. 2	6 41 0·6	23 35·51	103 29 12·8	6	6	Bessel, xx. 545
17	8 42 17·7	46 32·12	102 24 36·2	2	2	B.A.C. 7242
18	7 14 10·1	48 4·11	19 33·6	8	8	— —
19	6 9 41·1	49 38·83	102 14 27·6	2	2	— —
23	7 33 47·8	20 56 28·70	101 51 22·7	5	1	— 7296
Dec. 1	6 42 32·2	21 10 28·38	101 0 58·3	7	7	Bessel, xxi. 184

"The observations not on the meridian were taken with the Northumberland equatoreal. No correction has been applied for parallax. The places of the stars are adopted from the cited catalogues, with the exception of Bessel, xix. 1068; the mean place of which, 1847·0, was found by one transit and one circle observation to be,

$$\text{R.A.} = 19^h\ 41^m\ 50^s{\cdot}40, \quad \text{N.P.D.} = 104^\circ\ 18'\ 14''{\cdot}1,$$

differing considerably in R.A. from Bessel's place."

MAKERSTOUN. Equatoreal. (Sir T. M. Brisbane.)

	Makerstoun M.T.	R.A.	N.P.D.	No. of Comp.	Star of Comp.
	h m s	h m s	° ′ ″		
Sept. 10	9 20 40	19 43 35·48	104 14 17·0	10	B.A.C. 6776
13	8 14 0	43 37·03	17 32·5	9	— —
14	8 11 0	19 43 41·67	104 18 31·8	12	— —

The Makerstoun equatoreal is by Messrs. Troughton and Simms; the focal length of the telescope is 8½ feet; the object glass, a very fine one by Merz, has 6 inches aperture. The observations are made with a wire micrometer; power 95. The Makerstoun observations are corrected for refraction, but not for parallax.

Ephemeris. For 6^h Greenwich Mean Time.

By Mr. Hind, from M. d'Arrest's Second Elements.

1847.	R.A.	N.P.D.	1848.	R.A.	N.P.D.
	h m s	° ′ ″		h m s	° ′ ″
Dec. 24	21 53 52·1	97 54 32	Jan. 7	22 22 12·2	95 33 14
25	55 51·2	45 6	8	24 16·2	22 26
26	57 50·6	35 33	9	26 20·4	11 32
27	21 59 50·5	25 54	10	28 25·0	95 0 33
28	22 1 50·7	16 9	11	30 29·8	94 49 28
29	3 51·3	97 6 18	12	32 34·9	38 19
30	5 52·3	96 56 21	13	34 40·3	27 4
31	7 53·6	46 18	14	36 46·0	15 44
1848. Jan. 1	9 55·2	36 9	15	38 51·9	94 4 20
2	11 57·2	25 54	16	40 58·1	93 52 51
3	13 59·5	15 34	17	43 4·5	41 17
4	16 2·2	96 5 7	18	45 11·2	29 38
5	18 5·2	95 54 35	19	47 18·1	17 55
6	22 20 8·5	95 43 57	20	22 49 25·3	93 6 7

The correction for aberration is not applied in the ephemeris, but may be taken from the table subjoined and added to the ephemeris.

	Corr. for Aberr. R.A.	Corr. for Aberr. N.P.D.	497^s·8 × Δ	Hor. Par.		Corr. for Aberr. R.A.	Corr. for Aberr. N.P.D.	497^s·8 × Δ	Hor. Par.
	s	″	m s	″		s	″	m s	″
Dec. 24	−1·61	+7·6	19 27·8	3·66	Jan. 9	−1·76	+ 9·3	20 21·2	3·50
28	1·65	8·0	19 41·8	3·61	13	1·79	9·7	20 33·5	3·46
Jan. 1	1·68	8·5	19 55·4	3·57	17	1·83	10·0	20 45·4	3·43
5	−1·72	+8·9	20 8·5	3·53	21	−1·87	+10·3	20 56·9	3·40

NEPTUNE.

Observations.

CAMBRIDGE. In the Meridian. (Professor Challis.)

Compared with Mr. Adams's Ephemeris.

1847.	Greenwich M.T.	R.A.	Obs^d—Calc^d.	N.P.D.	Obs^d—Calc^d.
	h m s	h m s	s	° ′ ″	″
Sept. 24	9 49 16·6	22 2 4·16	−0·52	102 41 36·6	+0·2
25	45 15·8	1 59·19	·51	42 4·8	1·5
27	9 37 13·9	22 1 49·08	−0·91	102 42 57·4	+1·8

1847.	Greenwich M.T. h m s	R.A. h m s	Obsd—Calcd. s	N.P.D. ° ′ ″	Obsd—Calcd. ″
Oct. 6	9 1 11·6	22 1 9·85	—0·57	102 46 28·9	+1·4
7	8 57 11·7	1 5·84	·64	46 48·4	0·0
11	41 13·1	0 50·80	·87	48 7·7	1·2
12	37 13·9	0 47·51	·81	48 25·6	1·0
19	9 21·6	0 26·52	·89	50 17·2	3·1
20	5 23·1	0 23·95	·92	50 29·5	2·1
21	8 1 24·8	0 21·49	·97	50 43·3	3·4
25	7 45 32·9	0 13·27	·70	51 27·5	4·1
26	41 35·2	0 11·43	·72	51 35·9	3·2
Nov. 1	17 51·4	0 3·10	·71	52 16·4	2·2
2	7 13 54·6	22 0 2·18	·67	52 22·3	3·6
10	6 42 24·1	21 59 58·96	·94	52 33·2	3·7
15	22 47·1	22 0 1·49	0·84	52 17·5	4·1
16	18 51·7	0 1·99	(1·21)	52 15·5	(7·5)
18	11 2·4			52 1·0	5·9
19	6 7 7·8	22 0 5·80	—0·83	102 51 51·1	+3·5

"The parallax 0″·3 is taken account of. On Nov. 16 the observations were very uncertain, the planet being nearly hid by clouds."

MAKERSTOUN. Equatoreal. (Sir T. M. Brisbane.)

1847.	Makerstoun M.T. h m	R.A. h m s	N P.D. ° ′ ″	No. of Comp.	Star of Comp.
July 14	12 11	22 8 59·32	102 2 58·8	2	B.A.C. 7821
Aug. 2	10 51	7 20·32	12 25·0	6	— 7722
7	11 10	6 50·55	15 14·6	8	
22	12 16	5 17·32	23 59·3	7	
Sept. 4	10 59	3 56·78		8	
	11 0	3 56·65		15	— 7747
	11 10		31 26·9	3	— 7722
	11 25		31 24·2	7	— 7747
6	10 34	3 44·62	32 30·0	11	— —
13	8 58	3 3·68	36 13·2	7	— —
Oct. 25	8 25	0 12·95	51 28·1	5	— —
27	7 0	0 9·70	51 45·1	7	— —
28	6 40	0 8·15	51 54·0	10	— —
29	7 40	22 0 6·50	51 59·1	1	— —
Nov. 8	7 50	21 59 59·04	52 35·1	8	— —
9	7 55	59 59·01	52 34·6	8	— —
12	7 43	21 59 59·70	52 28·6	3	— —
16	7 47	22 0 2·56	52 11·6	10	— —
17	8 15	0 3·39	52 5·6	4	— —
19	7 43	0 5·80	51 49·9	7	— —
Dec. 3	6 47	22 0 37·65	102 48 52·1	6	— —

All the observations have been corrected for refraction.

Ephemeris. By Mr. Adams.

Greenwich Mean Midnight.

	R.A.			N.P.D.				R.A.			N.P.D.		
1847.	h	m	s	°	′	″	1848.	h	m	s	°	′	″
Dec. 12	22	1	12·85	102	45	37·1	Jan. 6	22	3	34·22	102	32	42·5
13			17·21		45	13·1	7			41·13		32	4·8
14			21·69		44	48·4	8			48·12		31	26·6
15			26·28		44	23·1	9		3	55·20		30	48·0
16			30·99		43	57·2	10		4	2·35		30	9·0
17			35·81		43	30·7	11			9·58		29	29·5
18			40·75		43	3·6	12			16·88		28	49·7
19			45·80		42	35·9	13			24·26		28	9·4
20			50·96		42	7·5	14			31·70		27	28·8
21		1	56·23		41	38·7	15			39·22		26	47·8
22		2	1·60		41	9·3	16			46·80		26	6·4
23			7·08		40	39·2	17		4	54·45		25	24·7
24			12·67		40	8·6	18		5	2·17		24	42·6
25			18·36		39	37·4	19			9·94		24	0·2
26			24·15		39	5·7	20			17·78		23	17·5
27			30·05		38	33·4	21			25·67		22	34·4
28			36·04		38	0·6	22			33·62		21	51·0
29			42·13		37	27·3	23			41·62		21	7·4
30			48·32		36	53·4	24			49·68		20	23·4
31		2	54·60		36	19·1	25			57·79		19	39·2
1848. Jan. 1		3	0·98		35	44·2	26		6	5·95		18	54·7
2			7·45		35	8·8	27			14·15		18	9·9
3			14·01		34	33·0	28			22·41		17	24·9
4			20·66		33	56·6	29			30·70		16	39·7
5	22	3	27·40	102	33	19·8	30			39·04		15	54·2
							31	22	6	47·43	102	15	8·5

Horizontal Parallax = 0″·28.

Sweeping Ephemeris for the expected Comet of 1264 *and* 1556 From Mr. Hind's Tables in the *M. Notice* for April 1847, p. 264.

	P.P. Feb. 10.				P.P. March 11.				P.P. April 10.			
	R.A.		N.P.D.		R.A.		N.P.D.		R.A.		N.P.D.	
1848.	h	m	°	′	h	m	°	′	h	m	°	′
Jan. 1	15	23	105	24	13	37	105	58				
11	16	31	105	14	14	18	107	15	12	44	106	41
21	17	49	103	40	15	12	107	52	13	7	108	2
31	19	12	100	53	16	23	107	5	13	38	109	13
Feb. 10	20	33	97	56	17	50	103	59	14	22	109	54
20	21	46	95	31	19	20	98	54	15	32	109	3

As the Comet is expected to appear very shortly, if at all, observers are particularly requested to be on the look-out for it.

MISS MITCHELL'S COMET.

Observations.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

	Greenwich M.T.	R.A.	N.P.D.	No. of Comp.	Star of Reference.
1847.	h m s	h m s	° ′ ″		
Oct. 11	7 42 20·7	16 33 8·19	51 17 35·5	3	*η Herculis*
	8 58 57·3	32 50·90	48 15·1	4	Bessel Z. 421, 16h 34m 2s
12	7 55 5·8	16 28 19·57	60 57 46·2	4	—— 367, 16 29 51
	8 0 10·0	28 18·14	59 54·1	6	—— 367, 16 25 34

Elements.

By Mr. Rümker.

Perihelion Passage, Nov. 14·418558, Greenwich M.T.

	° ′ ″	
Longitude Perihelion	274 23 38·6	Eq. Oct. 11.
Ascending Node...	190 51 40·8	
Inclination	71 57 45·9	
Log *q*	9·51875966	Motion Retrograde.

From the Roman observation of Oct. 3, and the Hamburg observations of Oct. 11 and 17.

By Mr. N. Pogson.

T 1847, Nov. 14·40316, Greenwich M.T.

	° ′ ″	
ϖ	274 10 57·8	M. Eq. 1847·0.
☊	190 50 21·0	
i	71 49 36·5	
Log *q*	9·516912	Motion Retrograde.

"The errors at the time of the second observation are,—

In Longitude +34″·5 In Latitude +49″·2

From observations by the Rev. W. R. Dawes on Oct. 7, 11, and 17, all the small corrections being taken into account."

Ephemeris.

By Mr. George Rümker.

For Greenwich Mean Midnight.

	R.A.	Decl.		R.A.	Decl.
	° ′	° ′		° ′	° ′
Dec. 10·5	227 37	−9 55	Dec. 22·5	230 38	−0 3
12·5	228 7	8 15	24·5	231 8	+1 35
14·5	228 36	6 35	26·5	231 38	3 14
16·5	229 6	4 57	28·5	232 8	4 53
18·5	229 37	3 18	30·5	232 37	+6 32
20·5	230 7	−1 41			

COLLA'S COMET.

Observations.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1847.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Weight.	Reference Stars.
Nov. 24	6 16 11·6	17 34 31·86	31 9 45·0	1	B.A.C. 5918, Arg. Z. 117; 90
29	8 15 6·9	17 57 13·64	31 41 31·4	4	Arg. Z. 117; 113, 120
Dec. 5	6 48 28·1	18 22 38·12	32 24 36·2	8	45 *Draconis* Arg. Z. 20; 15
6	6 42 57·9	18 26 47·08	32 32 31·1	2	45 *Draconis*
8	7 5 52·8	18 35 1·03	32 48 51·6	6	Arg. Z. 20; 28

"These places are corrected for parallax by Littrow's ephemeris. The comet was of the last degree of faintness, and observations of it were obtained with great difficulty.

"On Nov. 24, Dec. 5, and Dec. 6, the comet was referred to a single small star in its immediate neighbourhood by measures of differences of north polar distance and angles of position: on the other two days it was referred to *two* small stars by angles of position only. The stars of immediate reference were subsequently compared with those named above. Where two are mentioned, it is to be understood that the position of the comet depends on both *equally*. The weights assigned to the several positions are estimated from a consideration of the number of measures and all the circumstances of the observations. On Nov. 24 the observations were interrupted by the rising of the moon. On Dec. 6 the comet could not for a considerable time be detected on account of its being very near a star of the 10th magnitude, with which, after emerging from its rays, it was compared by a measure of difference of north polar distance and an estimated angle of position. On Dec. 5 I was able to use a power of 240. All the measures were taken with the instrument carried by clock movement, the faintness of the object making this precaution necessary."

STARFIELD. 20-foot Reflector. (Mr. Lassell.)

		Comet—Star.			
1847.	Greenwich M.T. h m s	R.A. m s	N.P.D. ′ ″	No. Obs.	Star of Comparison.
Nov. 23	6 40 26		+1 57·9	8	
	6 52 30	+0 33·30		3	
Dec. 1	8 11 29	−0 19·90		16	Arg. Z. 117; 128
	8 47 55		−6 54·7	16	
	9 20 53	−0 7·64		9	
14	8 41 36		−2 9·3	5	Star comp^{d} with Arg. Z. 38; 2
	9 7 13	+0 15·80		7	= —— 130; 102
	9 31 46		−1 51·3	4	
	10 25 19	+0 28·60		4	

"On Nov. 23 the star of comparison was one of (8·9) magnitude, which precedes another of (7·8) magnitude 1^{m} 51^{s}·7 in right ascen-

sion, and is 3′ 46″ to the north of it. The approximate apparent place of the second star is ”

R.A. $17^h\ 31^m\ 31^s$ N.P.D. 31° 7′ 10″

Adopting Argelander's places, and correcting the observations for parallax, the following positions of the Comet have been deduced:

1847.	G.M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
Dec. 1	8 46 10	18 6 1·03	31 55 34·7
14	9 26 30	18 59 7·83	33 41 14·1

ANNULAR ECLIPSE OF OCT. 8–9, 1847.

Captain Jacob writes that "the eclipse was observed at Bombay,

	Bombay M.T. h m s
Eclipse begins	1 7 36
Annulus forms	2 53 43
breaks	3 1 15·5
Eclipse ends	4 28 6

"From the place of observation the lighthouse bears S. 18° 40′ W., and Malabar Point flagstaff, S. 88° 55′ W.: these two are points in the trigonometrical survey; but I have not the survey data, with the exception of the latitude, 18° 53′ 40″, and longitude, 72° 51′ 12″ of the lighthouse. From these and a good map of Bombay, I get for my position, latitude, 18° 56′ 14″, and longitude, 72° 52′ 07″. The survey longitudes are believed to be erroneous in defect rather more than 1′. The bearings were determined by measurement with a pocket sextant from the setting sun, and are probably within 2′ of the truth. The times of the beginning and end of the eclipse are uncertain; the former to 4^s or 5^s, the eye having been withdrawn from the telescope at the moment; the latter to 2^s or 3^s from the sun's limb being tremulous. The times of the annular phase were considered exact, and the resulting longitude of the place comes out $\left\{\begin{matrix} 4^h\ 51^m\ 37^s.5 \\ 37.8 \end{matrix}\right\}$ or $\left\{\begin{matrix} 72^\circ\ 54'\ 22'' \\ 27 \end{matrix}\right\}$ from these two times.

"The day was remarkably clear for the season, not a cloud having passed until near the end of the eclipse. Shortly before the annular phase, a faint ray or brush of light was seen issuing from the sun's northern cusp, which soon after extended in both directions as a tangent to the sun's limb: nothing of the kind was visible at the other cusp; possibly it arose from a passing film of vapour.

"When the annulus was about forming, the first thing noticed was the light running rapidly round on the south side, leaving a break of considerable extent, which seemed to arise from a projecting table-land in the moon. This was soon withdrawn, and at the same instant a kind of ligament, or stalk, of about 1′ in breadth, was seen attaching the moon's limb to that of the sun, which was now quite clear, this small spot only excepted; the moon's limb was also perfectly well defined except in this point. The ligament

lasted for 3^s or 4^s,—perhaps more, elongating as the moon advanced, and was at length suddenly retracted into her circumference, the end appearing broken or toothed. At the breaking of the annulus the phenomenon was different; the moon's limb continued to approach that of the sun, till, when very close, a portion of the former, about 30° in extent, suddenly flowed over in dark lines, with bright spaces between, which almost immediately vanished, the whole appearance not lasting above 2^s. The first appearance was like that shewn in Pl. I. Fig. 10 of the Society's *Memoirs*, vol. x., and the last more resembled Figs. 1 and 3 of the same plate, but the lines were more numerous though they could not be counted. The telescope used was a 3½-foot by Dollond, with a power of 40.

"Not being in good health, I was unable to make any further observations of importance, except that the temperature of the air fell during the eclipse from 87° to 84°·5, and rose again to 85°·5 at the termination; and that, while the annulus lasted, the sun's rays had scarcely a perceptible effect on the thermometer.

"The time of the retraction of the ligament was noted as that of the formation of the annulus; and the time when the lines began to run across as the time of the end of the same. No light could be seen round the moon's limb when *off* the sun, either before or after the annulus."

BEADS IN ANNULAR ECLIPSES.

By the Rev. Professor Baden Powell.

The author considers the fact of the existence of the phenomenon in question as sufficiently well established, notwithstanding the equally admitted discrepancies in the accounts given of the appearance of the beads by different observers. Observers differ as to such points as the stationary or fluctuating character of the beads and the degree of their changes into threads; and they have sometimes been seen by one observer and not by another when the circumstances have been in some degree different. These discrepancies the author thinks due in some cases to the different coloured glasses employed, and in others to the loss of light, as, for example, when the images are projected on a screen. He thinks Mr. Caldecott's explanation of the tremulousness of the beads (as being due to atmospheric mirage) unsatisfactory, and is rather inclined with Mr. Airy to attribute it, in part, to the rapid decrease of the intensity of the sun's light near the borders.

The author considers the whole of the phenomena that have been observed to be due to two causes, viz. to the rapid decrease of light at the sun's edge, and to the acknowledged law of irradiation, that it increases with the increase of the intensity of the light.

This being allowed, he imagines that "any small opening or notch on the moon's edge will give rise to an enlarged image or patch of light by irradiation; and that this will be ***much greater*** as

the part occasioning it is further advanced on the sun's disk," thus the formation of *beads* is accounted for, and their elongation.

"Again, when the junction is broken, the same causes will account for the *widening* of the separation, and that in a *greater degree towards the sides* which are more remote from the circumference."

The author then proceeds to illustrate his explanation by means of diagrams applying to the different phases of the phenomenon; and he considers the principles laid down in explanation to possess the character of a "*vera causa,*" though they may not suffice to explain all the phenomena.

Differences in the appearances of the beads as described by different observers must also be expected, both from the preceding theory, and from the circumstance that there are differences in the *power* and *aperture* of the *telescopes* employed; the author hopes shortly to be able to offer to the Society some contributions towards the better elucidation of this subject.

It is perhaps questionable whether the same principles will afford an explanation of certain apparently analogous phenomena observed in the transits of *Venus;* but, in general, the adherence of the planet to the limb of the sun by a neck at the point of junction, and the protuberance of the disk towards the same part of the separation, are appearances which agree sufficiently with the cause above assigned.

In a note appended to Professor Powell's paper, he alludes to the observations of the eclipse of October 9 of the present year, in which small beads were observed, with waving in the limb, but without increase, or elongations of the shadows into threads, or any other change. In the case of M. Schaub's observations, the complementary combination employed might, by the loss of light, have destroyed any effects of irradiation. Also, as the ring formed was very thin, the difference of the intensities of the sun's light for the breadth of the band would be very small; and thus the causes above referred to might not act to a perceptible extent: the whole of the phenomena might be simply accounted for, as M. Mauvais observes, by the mere consideration of the irregularities of the moon's limb as it just touched that of the sun.

Results deduced from the Occultations of Stars and Planets by the Moon. Observed at Cambridge Observatory from 1830 *to* 1835. By the Astronomer Royal.

These occultations were reduced at the time in the most complete manner which was then practicable. A very approximate place of the star having been assumed, the apparent place of the point of the moon's limb at which the occultation took place was known, and by the application of the proper correction for parallax, the geocentric place of the same point for the instant of occultation was also known. The geocentric place of the moon's centre was

computed for the instant of occultation, according to the Lunar Tables. From the spherical co-ordinates of these two points, their distance was computed, which ought to be equal to the tabular semidiameter of the moon. Any discordance must arise from some of the following sources,—an error in the assumed R.A. or N.P.D. of the star, an error in the tabular R.A. or N.P.D. of the moon, an error in her parallax or semidiameter, or in the time of observation. The effects of errors of all these kinds (except that of the moon's semidiameter), upon the computed distance between the moon's centre and the point on her limb, were calculated and expressed symbolically; and, finally, the computed distance, with the addition of these symbolical terms, was made absolutely equal to the tabular diameter, with the addition of a symbolical term: thus the final equation contains one numerical term derived from the observation, and seven symbolical terms. This is essentially the simplest and most complete result which can be derived from the observation of an occultation; and if the numerical values of any one of the symbols shall become known, such symbols may, by numerical substitution, be removed from the equation.

The equations, in the form just described, are published in the various volumes of the Cambridge Observations from 1830 to 1835.

The form can now be simplified for the following reasons:—

1st. The stars have been carefully determined, hence the symbols for their errors in R.A. and N.P.D. can be got rid of in all cases. The same may be said, with few exceptions, of the places of the occulted planets.

2nd. Mr. Henderson's investigation of the value of the Horizontal Parallax of the Moon (*Mem. Roy. Ast. Soc.*, vol. x.) enables us to remove the corresponding symbol.

3rd. An error had been committed in the computation of the symbolical factor respecting the correction to be made to the time of observation. The change in the place of the moon's centre had been correctly computed, but the change in the correction for parallax, consequent on a change in the hour angle depending on a correction for time, had been omitted. The equations are now cleared of this fault.

To facilitate the application of the results to Lunar theories, the form of the equations has been changed; and they now depend on errors of Longitude and Ecliptic North Polar Distance, and not on errors of R.A. and N.P.D.

It was not thought advisable to introduce into the equations the numerical correction of the moon's semidiameter, as deduced from transit and circle observations, as it would be hazardous to assume that this semidiameter is necessarily the same as the semidiameter of the opake body behind which the occultations occur.

To the year 1833 inclusive, the Lunar Elements are computed from the *Berliner Jahrbuch:* for 1834 and 1835, they are derived from the *Nautical Almanac.* The computations have been partly made by Mr. Glaisher, partly by Mr. H. Breen, jun.; and the

Astronomer Royal places great reliance on the accuracy of the results.

The Memoir is divided into Three Sections.

Sect. I. Places of the Occulted Stars adopted for computation.

Sect. II. Correction of the assumed value of Horizontal Parallax, and Correction of the Factor of the Error of Time, depending on the change of Parallax during the error of time.

Sect. III. Transformation of the final equations from the form depending on errors of the moon's place in R.A. and N.P.D. to a form depending on errors of the moon's place in Longitude and Ecliptic North Polar Distance: and exhibition of the final results.

Letter from the Rev. W. R. Dawes.

"On the first of last month, while tracing the southern limits of the great nebula in *Orion*, my attention was attracted by the appearance of the star which stands on the point of the *proboscis major*. With my 8½-foot equatoreal, power 195, the star was distinctly separated into two, whose magnitudes were carefully estimated to be the eighth and ninth. I have since searched in vain for any notice of the duplicity of this star; yet it must have come under the eye of every observer who has scrutinised the ramifications of this most extraordinary of the nebulæ. In the map of the regions and stars of the nebulæ, presented by Sir John Herschel to the Astronomical Society in 1826, and contained in vol. ii. of the *Memoirs*, this star is inserted, and denominated *A*. The same designation is given to it in the catalogue of the stars in the nebula given by Sir John in page 28 of his *Results of Astronomical Observations made at the Cape*, in which it stands as No. 135. It is there called 6·7 magnitude, which is far brighter than it appears in *this* latitude: yet its identity is unquestionable. Though one of the most conspicuous stars in that part of the nebula, and inserted with perfect accuracy from micrometrical observations in the beautiful plate in Sir John's volume of *Results*, yet no intimation is given of its being double. Neither does it appear in the catalogue of Double Stars, observed with the 20-foot reflector. It seems scarcely probable that if, ten years ago, it presented its present appearance, it should not have been recognised under the power of the 20-foot reflector, and within 30° of the zenith. This would perhaps be more extraordinary than that it should have escaped detection by Mr. Cooper with his gigantic refractor, or by Dr. Lamont with the large telescope of 11¼ inches aperture at the Royal Observatory at Munich (whose observations of the nebula are specially referred to by Sir John Herschel), or by Struve at Dorpat, or finally by De Vico at Rome, who seems to have paid great attention to this

object, and in whose picture the star in question appears as of the eighth magnitude, which is also assigned to it by Lalande, in whose catalogue it stands as No. 10567. The unavoidable inference would seem to be that the star must have emerged from a single state within the last ten years. But if its change has been so rapid, it is surprising that it was never observed to be double *previously to its closing*, either by Struve in his sweeps for double stars, or by the scrutinising eye of Sir W. Herschel, who brought some of the largest and most perfect of telescopes to bear upon it. If, on the other hand, the star has always been as distinctly double as it is now, then it would be difficult to say what amount of non-observation may be received as conclusive evidence of non-existence. The object is, at any rate, one of peculiar interest; and I would earnestly request attention to it by such observers as possess instruments competent to its satisfactory measurement. Its mean place for 1848·0 is R.A. $5^h\ 28^m\ 27^s$; N.P.D. $95^\circ\ 43'\ 47''$."

The star Weiss xx, 122, supposed to be missing, is inserted in the Berlin Map, Hora xix, published in 1840.—(R. W. R.)

MONUMENT TO NEWTON.

An Obelisk, 64 feet high, has been erected by the Rev. Charles Turnor, in the park of Stoke Rochford, Lincolnshire, the residence of his nephew, Christopher Turnor, Esq. Newton, when a child, went to a little day-school at Stoke, which gives propriety to the site. The Inscription is as follows:—

IN MEMORY
OF
SIR ISAAC NEWTON,
WHO WAS BORN AT WOOLSTHORPE,
AN ADJOINING HAMLET,
AND
RECEIVED THE FIRST RUDIMENTS OF HIS EDUCATION
IN THE PARISH OF STOKE.

THIS OBELISK WAS ERECTED
BY
CHARLES TURNOR, M.A. F.R.S.
PREBENDARY OF LINCOLN,
A.D. MDCCCXLVII.

**MAY THE INHABITANTS OF THE SURROUNDING DISTRICT
RECOLLECT WITH PRIDE THAT SO GREAT A PHILOSOPHER
DREW HIS FIRST BREATH IN THE IMMEDIATE NEIGHBOURHOOD
OF THIS SPOT;
AND MAY SUCH FEELINGS LONG BE PERPETUATED
BY THIS MONUMENT,
WHICH RECORDS THE VENERATION OF POSTERITY
FOR THE MEMORY
OF THAT ILLUSTRIOUS MAN.**

Printed by George Barclay, Castle Street, Leicester Square.

ROYAL ASTRONOMICAL SOCIETY.

VOL. VIII. *January* 14, 1848. No. 3.

Sir John F. W. Herschel, Bart., President, in the Chair.

Edward Joseph Lowe, Esq., of Highfield House, near Nottingham, was balloted for, and duly admitted a Fellow of the Society.

FLORA.

Observations.

Göttingen. Meridian. (Professor Gauss.)

1847.	Göttingen M.T. h m s	R.A. ° ′ ″	N.P.D. ° ′ ″
Dec. 10	11 11 4	66 47 26·2	75 37 9·9
11	6 7	32 5·4	34 17·4
12	11 1 11	66 16 59·8	75 31 20·0

Hamburg. Meridian Circle. (M. Rümker.)

1847.	Hamburg M.T. h m s	R.A. ° ′ ″	N.P.D. ° ′ ″
Nov. 16	13 10 50·1	73 9 28·4	76 13 18·3
17	5 59·2	72 55 41·3	12 52·9
18	13 1 6·8	72 41 31·8	12 27·1
21	12 46 21·7	71 57 3·8	10 33·8
22	41 23·1	41 37·4	9 45·8
24	31 26·3	71 10 1·4	7 47·8
27	16 23·5	70 21 8·0	4 7·9
28	12 11 21·4	70 4 31·0	76 2 41·9
Dec. 1	11 56 13·8	69 14 26·4	75 57 46·7
4	41 6·4	68 24 22·2	51 53·7
7	26 2·0	67 35 4·1	44 59·0
8	11 21 1·7	67 18 56·3	42 29·9
18	10 32 4·3	64 53 57·4	11 15·6
19	27 18·8	41 31·5	7 35·0
20	10 22 35·6	64 29 38·4	75 3 45·7

HAMBURG. With the Equatoreal and Micrometer. (M. Rümker.)

1847.	h	m	s	°	′	″	°	′	″
Nov. 21	9	1	7·8	71	59	35·1	76	10	38·2
25	8	21	7·5	70	55	46·4	76	6	55·6
Dec. 4	9	14	4·4	68	26	6·6	75	52	7·6
6	15	5	29·1	67	50	10·7	75	47	13·5
17	7	43	45·4	65	8	31·6	75	15	23·2

WASHINGTON. (Lieut. M. F. Maury, U.S.N.)

	Washington M.T.			R.A.			N.P.D.			No. of Obs.		Instrum.	Star of Comp.
1847.	h	m	s	h	m	s	°	′	″	R.A.	N.P.D.		
Nov. 29	12	5	11	4	39	5·64	76	0	46·1	2	1	*Mer. C.	
						5·51				1		W. Tran.	
Dec. 3	11	44	55		34	27·70	75	53	25·2	1	1	Mur. C.	*a* in R.A.
	13	25	15			22·37			19·2	18	6	Equat.	*a*
4	6	54	30		33	35·16				8		Equat.	*b*
	6	46	40				75	51	45·2		2	—	*b*
6	8	0	23		31	19·44	75	47	8·2	12	5	—	*b* and *c*
	11	29	50		31	9·51				7		W. Tran.	
						9·83	75	46	48·9	7	1	Mer. C.	
									48·8		1	Mur. C.	
7	11	24	49		30	4·35	75	44	21·1	7	1	Mer. C.	
						4·48				5		W. Tran.	
							75	44	23·5		1	Mur. C.	
8	11	19	49	4	29	0·20				5		W. Tran.	
						0·38	75	41	51·1	7	1	Mer. C.	
									56·0		1	Mur. C.	

The observations are corrected for refraction only.

Mean Places of the Stars of Comparison, 1847·0:—

	R.A.			N.P.D.			Authorities.	
	h	m	s	°	′	″	R.A.	Decl.
a	4	33	25·76	75	58	18·7	Rümker, 1256.	Washington Obs.
b		37	54·23		45	8·7	Bessel, iv. 824, H. C. p. 203.	—
c	4	36	4·45	75	39	44·5	Rümker, 1265.	—

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* The names of the observers, though given by Lieut. Maury, are omitted here from want of space: there can be no doubt of their skill or fidelity. The wealth of the Observatory in instruments is rather perplexing: a large Equatoreal, a Transit, distinguished by its locality as West, a Meridian Circle, and a Mural Circle, have all been employed.

Elements. By Mr. Graham, of the Observatory, Markree.

Epoch 1848, Jan. 1·0, Greenwich Mean Time.

	°	′	″	
Mean Anomaly	35	33	0·27	
ϖ	33	26	55·31	Mean Eq. 1848·0
☊	110	13	26·98	
i	5	53	57·12	
ϕ	8	55	59 11	

$\mu = 1085''\cdot8205$ Log a = 0·3428324.

These elements are deduced from the South Villa Observations of October 18, and from the following Markree places:—

Greenwich M.T. 1847.	R.A. ° ′ ″	N.P.D. ° ′ ″
Nov. 17·569130	72 55 2·10	76 12 51·0
Dec. 18·462247	64 53 21·15	75 11 6·8

For the middle place:—

	Calcd—Obsd. ″
Longitude =	+ 1·3
Latitude =	−0·2

Ephemeris. For Greenwich Mean Midnight.

By Mr. Hind, from his *Third* Elements.

1848.	R.A. h m s	N.P.D. ° ′ ″	1848.	R.A. h m s	N.P.D. ° ′ ″
Feb. 1	4 18 36·97	71 9 30·0	Feb. 22	4 40 55·48	69 2 38·6
2	19 24·64	71 3 15·5	23	42 14·67	68 56 59·4
3	20 14·11	70 57 1·4	24	43 35·06	51 23·3
4	21 5·35	50 47·9	25	44 56·64	45 50·3
5	21 58·33	44 35·0	26	46 19·38	40 20·6
6	22 53·01	38 23·0	27	47 43·27	34 54·2
7	23 49·38	32 12·0	28	49 8·28	29 31·3
8	24 47·39	26 1·8	29	50 34·40	24 12·1
9	25 47·01	19 52·7	March 1	52 1·61	18 56·6
10	26 48·21	13 44·8	2	53 29·88	13 44·9
11	27 50·96	7 38·3	3	54 59·20	8 37·1
12	28 55·23	70 1 33·3	4	56 29·56	68 3 33·4
13	30 1·01	69 55 30·0	5	58 0·93	67 58 33·8
14	31 8·25	49 28·5	6	4 59 33·28	53 38·4
15	32 16·93	43 29·0	7	5 1 6·60	48 47·3
16	33 27·02	37 31·6	8	2 40·86	44 0·7
17	34 38·48	31 36·4	9	4 16·04	39 18·6
18	35 51·28	25 43·6	10	5 52·11	34 41·0
19	37 5·40	19 53·3	11	7 29·06	30 8·1
20	38 20·83	14 5·6	12	9 6·88	25 39·9
21	4 39 37·53	69 8 20·7	13	5 10 45·54	67 21 16·6

1848.	R.A. h m s	N.P.D. ° ′ ″	1848.	R.A. h m s	N.P.D. ° ′ ″
Mar. 14	5 12 25·02	67 16 58·3	April 8	5 57 30·21	65 59 29·3
15	14 5·31	12 45·0	9	5 59 25·48	57 42·2
16	15 46·37	8 36·9	10	6 1 21·18	56 1·6
17	17 28·18	4 33·9	11	3 17·28	54 27·5
18	19 10·74	67 0 36·2	12	5 13·76	52 59·9
19	20 54·02	66 56 43·8	13	7 10·63	51 38·8
20	22 38·01	52 56·8	14	9 7·84	50 24·3
21	24 22·69	49 15·3	15	11 5·40	49 16·5
22	26 8·05	45 39·3	16	13 3·31	48 15·3
23	27 54·08	42 8·9	17	15 1·53	47 20·7
24	29 40·76	38 44·2	18	17 0·05	46 32·8
25	31 28·08	35 25·2	19	18 58·86	45 51·6
26	33 16·02	32 12·0	20	20 57·97	45 17·0
27	35 4·58	29 4·6	21	22 57·38	44 49·2
28	36 53·74	26 3·1	22	24 57·08	44 28·1
29	38 43·48	23 7·5	23	26 57·05	44 13·7
30	40 33·80	20 17·9	24	28 57·28	44 6·1
31	42 24·67	17 34·3	25	30 57·75	44 5·2
April 1	44 16·10	14 56·9	26	32 58·45	44 11·1
2	46 8·07	12 25·6	27	34 59·38	44 23·9
3	48 0·56	10 0·5	28	37 0·53	44 43·5
4	49 53·56	7 41·6	29	39 1·90	45 9·9
5	51 47·04	5 29·0	30	41 3·49	45 43·2
6	53 40·98	3 22·7	May 1	6 43 5·27	65 46 23·3
7	5 55 35·37	66 1 22·8			

This ephemeris gives the places of the planet reckoned from the *true* equinox of date: the aberration has not been applied. By adding the correction due to aberration from the annexed table to the values of the ephemeris, the *apparent* places of the planet will be obtained.

1848.	Corr. for Aberr. R.A. s	Corr. for Aberr. N.P.D. ″	$497^{\mathrm{s}}{\cdot}8 \times \Delta$ m s	Hor. Par. ″	1848.	Corr. for Aberr. R.A. s	Corr. for Aberr. N.P.D. ″	$497^{\mathrm{s}}{\cdot}8 \times \Delta$ m s	Hor. Par. ″
Feb. 1	—0·37	—3·0	11 26·3	6·23	Mar. 20	—1·19	—2·6	16 27·0	4·33
5	0·44	3·1	11 49·6	6·02	24	1·25	2·4	16 52·7	4·22
9	0·51	3·1	12 13·5	5·82	28	1·32	2·1	17 18·2	4·11
13	0·58	3·2	12 37·9	5·63	April 1	1·37	1·9	17 43·7	4·01
17	0·65	3·2	13 2·6	5·46	5	1·43	1·6	18 9·0	3·92
21	0·72	3·2	13 27·6	5·29	9	1·49	1·3	18 34·0	3·83
25	0·79	3·2	13 52·9	5·13	13	1·54	1·0	18 58·8	3·75
29	0·86	3·1	14 18·4	4·98	17	1·60	0·7	19 23·3	3·67
Mar. 4	0·93	3·1	14 44·0	4·83	21	1·65	—0·3	19 47·6	3·60
8	1·00	3·0	15 9·7	4·69	25	1·69	0·0	20 11·5	3·53
12	1·06	2·9	15 35·5	4·56	29	—1·74	+0·4	20 35·1	3·46
16	—1·13	—2·7	16 1·3	4·44					

NEPTUNE.

Observations.

Hamburg. Meridian Circle. (M. Rümker.)

	Hamburg M.T.	R.A.	N.P.D.
1847.	h m s	° ′ ″	° ′ ″
Oct. 12	8 37 44·0	330 11 54·3	102 48 32·3
14	29 45·5	10 13·6	49 5·4
15	25 46·7	9 29·8	49 20·9
16	21 47·8	8 45·1	49 35·8
17	17 49·1	8 3·0	49 47·2
18	8 13 50·3	7 20·1	50 5·6
22	7 57 56·1	4 40·8	50 55·1
24	50 0·8	3 47·6	51 21·8
25	46 3·0	3 20·4	51 31·0
26	42 5·0	2 47·5	51 39·9
27	38 7·4	2 20·5	51 44·9
28	34 10·0	2 0·3	51 51·7
29	30 13·8	1 40·8	52 1·8
Nov. 2	7 14 24·2	330 0 26·8	52 26·2
10	6 42 54·0	329 59 41·7	52 33·9
17	15 27·2	330 0 50·5	52 8·8
18	6 11 32·7	1 10·9	51 59·3
21	5 59 49·0	2 11·4	51 34·7
24	48 6·4	3 29·6	51 6·4
27	36 25·4	5 9·4	50 27·5
28	32 31·7	5 44·1	50 12·2
Dec. 4	5 9 13·8	10 7·4	48 38·0
8	4 53 44·2	13 38·5	47 19·9
12	38 16·4	17 37·0	45 49·3
17	4 18 59·5	330 23 18·5::	102 43 49·6:

Transit. (Mr. George Rümker.)

	Hamburg M.T.	R.A.		Hamburg M.T.	R.A.
1847.	h m s	° ′ ″	1847.	h m s	° ′ ″
Sept. 7	10 58 11	330 54 36·7	Oct. 25	7 46 3	330 3 21·4
10	46 6	50 10·0	26	42 5	2 46·8
15	25 58	43 0·1	Nov. 2	7 14 24	0 27·7
18	10 13 54	38 58·5	18	6 11 33	1 12·4
26	9 41 45	28 35·1	21	5 59 49	2 7·7
27	37 44	27 25·9	27	36 26	5 12·6
Oct. 4	9 9 42	19 32·8	28	32 31	5 41·1
12	8 37 44	11 56·1	Dec. 4	5 9 14	10 11·3
24	7 50 1	330 3 50·0	12	4 38 17	330 17 41·2

Elliptic Elements. By Professor S. C. Walker.

	°	′	″	
Epoch	328	31	56·36	G. M. Noon, Jan. 1, 1847
Longitude Perihelion	48	21	2·93	M. E. Jan. 1, 1847
Ascending Node	130	4	35·03	
Inclination	1	46	59·54	
Excentricity	0·00857741			

Mean Daily Siderial Motion 21″·55448 Period 164·6181 Tropical Years.

“ On applying the perturbations computed by Professor Peirce to the true longitude and radius vector, the ephemeris affords the following comparison with direct observation :—

		R.A. Obsd—Calcd.	Decl. Obsd—Calcd.
		″	″
1795	May 9	+3·1	—0·7
1846	Nov. 7	—2·7	1·2
1847	April 6	—1·3	2·5
1847	Aug. 22	+0·3	—0·1

“ A change of one year in the periodic time would vary the relative differences of the computed places for Nov. 7, 1846, and April 6, 1847, by 11″·4.”

Perturbations.

By Professor Peirce, of the University of Cambridge, U.S.

“ The following formulæ are expressions of a first approximation to a theory of the perturbations of *Neptune* by the other planets. All the terms (as high as the first power of the excentricity of the disturbing planets) are retained, which can affect the longitude 0″·01 ; the terms dependent on the squares of the excentricities, as well as those which depend on the excentricity of *Neptune*, are neglected. The relative inclinations of the orbits, the secular changes in the elements of the disturbing planets, and the great inequality of the motions of *Jupiter* and *Saturn*, are also neglected. Mr. S. C. Walker's elements of *Neptune* are adopted, neglecting the excentricity and assuming (for convenience of computation) a mean motion exactly half that of *Uranus*. The elements of the disturbing planets are taken from Bouvard's tables. The masses are

$$\text{Jupiter} = \frac{1}{1048}; \quad \text{Saturn} = \frac{1}{3501}; \quad \text{Uranus} = \frac{1}{24605}.$$

The last being taken from Lamont's determination. The neglected terms are so small or of so long a period, that they cannot materially interfere with the principal design of this approximation, which is that of enabling astronomers to free the observations of *Neptune* from the effects of perturbation, and thus to obtain the true elliptic elements which may be used for a complete theory of the planet. The mean longitude of each planet is denoted by its

initial letter, and the longitude of the perihelion by prefixing ϖ to the symbolic letter; t is the number of Julian years after Jan. 1, 1850."

Perturbations of True Longitude, v.

$$
\begin{aligned}
\delta v = & -(1''{\cdot}87 - 0''{\cdot}0688\,t)\sin(U-N) \\
& + (6{\cdot}55 - 0{\cdot}2903\,t)\cos(U-N) \\
& - 7''{\cdot}40\sin 2(U-N) - 0''{\cdot}87\cos 2(U-N) \\
& - 1{\cdot}56\sin 3(U-N) - 0{\cdot}10\cos 3(U-N) \\
& - 0{\cdot}47\sin 4(U-N) - 0{\cdot}10\cos 4(U-N) \\
& - 0{\cdot}19\sin 5(U-N) - 0{\cdot}06\cos 5(U-N) \\
& - 0{\cdot}08\sin 6(U-N) - 0{\cdot}03\cos 6(U-N) \\
& - 0{\cdot}04\sin 7(U-N) - 0{\cdot}02\cos 7(U-N) \\
& - 0{\cdot}02\sin 8(U-N) - 0{\cdot}01\cos 9(U-N) \\
& + 0''{\cdot}0404\,t - 0''{\cdot}001851\,t^2 + 0''{\cdot}0168\,t\,.\cos(N-\varpi U) \\
& + 18{\cdot}35\sin(S-N) - 0''{\cdot}28\sin 2(S-N) - 0''{\cdot}02\sin 3(S-N) \\
& + 0{\cdot}25\sin(S-2N+\varpi S) + 0''{\cdot}01\sin(S-\varpi S) \\
& + 0{\cdot}36\sin(2S-3N+\varpi S) + 0''{\cdot}52\sin(2S-N-\varpi S) \\
& + 0{\cdot}01\sin(3S-2N-\varpi S) + 0''{\cdot}0025\,t\,.\cos(N-\varpi S) \\
& + 33{\cdot}59\sin(J-N) - 0''{\cdot}01\sin 2(J-N) \\
& + 0{\cdot}01\sin(J-2N+\varpi J) + 0''{\cdot}80\sin(2J-N-\varpi J) \\
& + 0{\cdot}0035\,t\cos(N-\varpi J) + 0''{\cdot}02\sin(E-N)
\end{aligned}
$$

Perturbations of Radius Vector, r.

$$
\begin{aligned}
\delta r = & \quad 0{\cdot}0000123\,t + 0{\cdot}01346 \\
& + (0{\cdot}00236 - 0{\cdot}0000128\,t)\cos(U-N) \\
& - (0{\cdot}00015 + 0{\cdot}0000156\,t)\sin(U-N) \\
& + 0{\cdot}00091\cos 2(U-N) - 0{\cdot}00012\sin 2(U-N) \\
& + 0{\cdot}00021\cos 3(U-N) - 0{\cdot}00005\sin 3(U-N) \\
& + 0{\cdot}00007\cos 4(U-N) - 0{\cdot}00002\sin 4(U-N) \\
& + 0{\cdot}00006\cos 5(U-N) - 0{\cdot}00001\sin 5(U-N) \\
& + 0{\cdot}00001\cos 6(U-N) + 0{\cdot}00001\cos 7(U-N) \\
& + 0{\cdot}0000114\,t\sin(N-\varpi U) \\
& + 0{\cdot}00275\cos(S-N) + 0{\cdot}00003\cos 2(S-N) \\
& + 0{\cdot}00003\cos(2S-N-\varpi S) - 0{\cdot}00006\cos(N-\varpi S) \\
& + 0{\cdot}0000006\,t\sin(N-\varpi S) \\
& + 0{\cdot}00496\cos(J-N) + 0{\cdot}00013\cos(2J-N-\varpi J) \\
& - 0{\cdot}00019\cos(N-\varpi J) + 0{\cdot}0000003\,t\sin(N-\varpi J)
\end{aligned}
$$

"The perturbations for the following dates have been computed from the preceding formulæ, and must be added with reversed sign to the heliocentric longitudes and radii vectores deduced from observation, in order to obtain those which correspond to the pure elliptic motion."

			δv.	δr.				δv.	δr.
			″					″	
1795	May	9	+37·60	+0·01207	1847.	June	1	+30·65	+0·01458
1846	Sept.	1	+32·00	+0·01660		July	1	30·23	·01437
	Oct.	1	32·09	·01637		Aug.	1	29·76	·01417
	Nov.	1	32·11	·01613		Sept.	1	29·24	·01397
	Dec.	1	32·07	·01590		Oct.	1	28·67	·01378
1847	Jan.	1	+31·97	+0·01567		Nov.	1	28·06	·01360
	Feb.	1	31·82	·01545		Dec.	1	27·41	·01343
	Mar.	1	31·61	·01522	1848.	Jan.	1	+26·71	+0·01325
	April	1	31·34	·01501		Feb.	1	+25·97	+0·01308
	May	1	+31·02	+0·01479					

HEBE.

Observations.

WASHINGTON. Equatoreal. (Lieut. M. F. Maury, U.S.N.)

		Washington M.T.	R.A.	N.P.D.	Stars of Comp.	Mags. noted.
1847.		h m s	h m s	° ′ ″		
Aug.	10	9 33 25	16 55 17·28	98 59 3·1	B. xvii. 83	
	11	8 17 39	55 28·87	99 7 44·6	— 83	
	18	9 1 54	57 39·43	100 12 7·1	— 3	9; 9; 9·10
	19	8 44 14	58 4·09	21 7·9	— 3	9·10; 9·10
	20	9 7 3	16 58 31·30	100 30 21·4	— 3	9·10
	25	10 25 9	17 1 11·74	101 16 24·8	— 18	9·10; 9
	29	Star of Comparison not in Catalogues.				11·12
	30	7 49 59	4 23·83	102 0 5·6	B. xvi. 1139	9·10
Sept.	1	9 11 12	5 55·41	18 18·8	xvii. 155,179	11
	3	8 7 39	7 29·08	35 23·5	— 168	10; 10; 10
	4	7 42 9	8 16·72	102 43 57·9	B.A.C. 5845	10
	6	8 11 4	10 1·28	103 1 18·7	— —	10·11
	10	Star of comparison not in Catalogues.				11
	13	7 59 54	16 44·81	104 0 2·8	B. xvii. 366	10·11
	14	8 55 26	17 50·44	8 29·9	— —	11
	15	8 13 52	18 52·86	16 16·8	— 397	10·11
	16	7 37 20	19 56·47	24 6·1	— 462	10·11
	17	7 54 35	21 3·82	32 13·1	— 392	11·12
	20	7 29 20	24 31·04	104 55 30·8	B.A.C. 5949	11
	21	7 36 33	25 41·69	105 3 10·9	— —	10; 10·11
	22	7 33 50	17 26 54·46	105 10 42·2	— —	11·12

"These observations are corrected for refraction *only*."

"The change of magnitude did not, for some time, suggest to me the idea of a brighter and a darker side to the planet. The first remark to this effect is

entered in my memorandum-book on September 16. It is my habit to note the magnitudes of the new planets at least once during every night's work, and sometimes, when I am not satisfied, twice or thrice. On August 20th I remarked that the magnitude should not be rated higher than the 10 or 10·9 at the highest. On August 29 many observations were made, and I find written opposite the planet, 'difficult to recognise,' 'very faint,' and again, 'planet fading very fast.' On September 1 the planet was noted as 'not larger than 11 mag. I perceive that from night to night it grows fainter.' I only observed *Iris* once on October 3, when its magnitude was noted four times independently, and each time set down as the 9th."

IRIS.

Observations.

HAMBURG. (MM. C. and G. Rümker.)

	Hamburg M. T.	R. A.	N.P.D.	
1847.	h m s	° ′ ″	° ′ ″	
Oct. 10	6 42 3	299 13 32·7		Transit G. R.
11	39 1	299 27 3·0		——
15	27 8	300 24 51·0		——
16	6 24 13	300 40 19·5		——
25	5 59 4	303 14 23·1		——
26	56 23	303 32 58·6		——
Nov. 17	5 1 50·3	311 33 35·6	102 25 25·3	Mer. Circ. C. R.
18	4 59 32·3	311 58 8·0	102 20 13·2	——
28	6 46 54·0	316 16 4·5	101 20 57·6	Equatoreal.
Dec. 1	7 40 37·6	317 37 23·8	101 0 40·5	——
4	6 17 52·2	318 57 25·1	100 40 3·8	——
8	7 34 16·2	320 49 49·5	100 10 10·3	——
12	6 43 15·8	322 42 0·8	99 38 51·4	——

Elements. By Mr. Graham, of the Observatory, Markree.

Epoch 1848, Jan. 1·0, Greenwich Mean Time.

	° ′ ″	
Mean Anomaly………	330 20 16·70	
ϖ ……………………	42 2 1·49	Mean Eq.
☊ ……………………	259 53 3·11	Jan. 1, 1848.
i……………………	5 28 22·96	
φ ……………………	13 10 24·39	

μ…… 970″·6583 Log a…… 0·3752935

These represent accurately in latitude, and within 0″·2 in longitude, the middle place of the observations from which they are deduced; viz.

1847.	G.M.T.	R.A.	N.P.D.	
		h m s	° ′ ″	
Aug.	13·423819	19 57 29·44	103 27 28·5	South Villa.
Oct.	15·397950	20 1 48·97	104 13 16·7	Markree.
Dec.	18·290046	21 42 24·68	98 47 42·5	Markree.

I subjoin the equatoreal co-ordinates:

$$\begin{aligned}
M &= 131^\circ\ 13'\ 47''{\cdot}17 + 0''{\cdot}1376\,t + 1{\cdot}001\,E \\
N &= 40\ \ 30\ \ 53{\cdot}87 + 0{\cdot}1361\,t + 0{\cdot}991\,E - 0{\cdot}11\,d\omega \\
P &= 55\ \ 28\ \ 54{\cdot}94 + 0{\cdot}1335\,t + 0{\cdot}976\,E - 0{\cdot}60\,d\omega
\end{aligned}$$

$$\begin{aligned}
\text{Log}\,m &= 0{\cdot}3682635 - 0{\cdot}081\,t - 0{\cdot}59\,E \\
\text{Log}\,n &= 0{\cdot}3344921 - 0{\cdot}047\,t - 0{\cdot}26\,E - 8{\cdot}7\,d\omega \\
\text{Log}\,p &= 9{\cdot}9650937 + 0{\cdot}777\,t + 5{\cdot}22\,E + 47{\cdot}6\,d\omega
\end{aligned}$$

$$\begin{aligned}
\mu &= -0{\cdot}4001906 + 2{\cdot}414\,t + 17{\cdot}57\,E \\
\nu &= -0{\cdot}3198253 - 2{\cdot}435\,t - 17{\cdot}80\,E + 8{\cdot}4\,d\omega \\
\varpi &= -0{\cdot}1732753 - 1{\cdot}081\,t - 7{\cdot}72\,E - 15{\cdot}5\,d\omega
\end{aligned}$$

The co-ordinates referred to the true equinox are,

$$\begin{aligned}
x &= m \sin (M + \xi) + \mu \\
y &= n \sin (N + \xi) + \nu \\
z &= p \sin (P + \xi) + \varpi
\end{aligned}$$

where t denotes the days from the epoch, 1848, Jan. 1·0

E the Equation of the Equinoxes in Longitude.

$d\omega$ the Obliquity $- 23^\circ 27' 23''$

ξ the Excentric Anomaly.

The variations of log m, &c. are to be applied as if all the figures in log m, &c. were *integral* numbers.

SATELLITES OF SATURN.

Observations of Mimas, *the closest and most interior Satellite of Saturn.* By Mr. Lassell.

"It is to be regretted that, owing to the discovery of the closest two satellites of *Saturn* having been made at a period long after the five others became known, it is difficult, in referring to the individuals, to quote them by numerals which shall, explicitly and without ambiguity, point out which satellites are meant.

"Sir John Herschel, seeing this difficulty, has invented and published in his Cape Observations a nomenclature which completely removes it, and moreover will retain its precision should any more satellites hereafter be discovered. He gives a proper name to each of them, and, beginning with that nearest to *Saturn*, designates them thus: *Mimas*, *Enceladus*, *Tethys*, *Dione Rhea*, *Titan*, and *Japetus*. I cannot but think this nomenclature a great improvement, and worthy of general adoption.

"Of *Mimas*, the satellite I now refer to, I have obtained, in all, five observations:—

"1846, Aug. 25. About 11½ p.m. M.T. the satellite appeared at its greatest elongation westward. Aug. 30. The satellite ap-

peared a little short of its greatest elongation eastward; and again, on the 1st Sept. at 10 p.m., the satellite appeared a little beyond its greatest eastern elongation.

"During the late opposition of *Saturn*, although I have been very watchful of opportunities, I have been able to see it certainly but twice, viz. on the 16th October and 18th November.

"On the 16th Oct. at $8^h 35^m$ M. T. *Mimas* was, as nearly as I could estimate, exactly at its greatest western elongation, appearing to be five or six tenths of the length of the preceding arm of the ring distant from its extremity. This evening the satellite was better seen than on any other occasion.

"On the 18th Nov. at about 8½ hours, the satellite again appeared as nearly as possible in the same situation as on the 16th October. The power with which *Mimas* was generally best seen is a Coddington lens magnifying 567 times. The difference of visibility between *Mimas* and *Enceladus* is almost incomparable, the latter being instantly seen in my telescope, under all tolerable circumstances, when within 40° or 50° of its greatest elongation; whilst in any but the very finest circumstances *Mimas* is an object of great difficulty."

SATELLITES OF URANUS.*

Observations by Mr. Lassell.

"These observations are principally of the two brightest, those first observed by Sir W. Herschel, or I and II, with estimations of two others, presumed to be his inferior and middle satellites, or 1 and 2. I have not been able to obtain an undoubted observation of any satellite exterior to II.

"The observations are made in position and distance, like those of a double star. The positions are reckoned from the north point as zero, round by the *following* side.

"The results here presented are generally the means of two or three measures. The observations of the I and II, graphically projected, shew *apparently* elliptic orbits, having their transverse axes very nearly perpendicular to the plane of the ecliptic and the proportions of the axes, roughly, as 10 to 6.

"The results marked *e* are careful *estimations* only.

"As to the single observation of the satellite 2, there was unquestionably a point of light at the place indicated, which kept its relative position to the planet for about two hours. Moreover, that part of the sky in which *Uranus* was seen on Nov. 6 was carefully scrutinised on Nov. 8 without my being able to detect any stars in the places where the four satellites had been seen."

---

* As a temporary nomenclature, we call the two first discovered satellites I and II, and the others 1, 2, 3, 4, reckoning from the planet.

			1.		I.		2.		II.	
1848.		G.M.T.	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.
		h	°		°				°	
Sept.	14	13·6	10 *e*		322 *e*				334·7	
	27	9·8	326 *e*		160 *e*				345 *e*	
	29	11·5	336 *e*		38 *e*				302·1	28″·98
Oct.	1	12·5	348 *e*		334·6	32″·8			213·4	27·8
	2	10·5			307·7				192·1	
	11	11·2			294·6	20·57			332·7	41·39
	13	10·0			182 *e*				283·0	
	15	11·3			133·3	26·27			196·8	33·44
	16	9·5			77·6				180	29·15
	17	11·0			9·4	27·37			166·1	46·38
Nov.	1	9·4			150				144·1	33·33
	6	10·3	349 *e*	11″ *e*	262	20 *e*	80 *e*	10″ *e*	349	45 *e*
	8				187·2				316·5	
	9	9·5			284·1				163·8	

Note on the Satellites of Uranus. By M. Otto Struve.

The satellites of *Uranus* were first seen by Sir W. Herschel on Jan. 11, 1787, six years after his discovery of the primary planet. By a continued series of observations that year he established the undoubted existence and the approximate distance and periodic times of two *principal* satellites. In a second memoir (*Phil. Trans.* 1798) he announced the discovery of four new *supplementary* satellites; and in a third memoir (*Phil. Trans.* 1815) he presented the results of his observations to that date. The faintness of the objects observed and the mounting of his telescope* sufficiently account for discrepancies in Sir William's results. The measures in distance were, with his means, *exceedingly* difficult: hence we have only two such measures of the interior of the two principal satellites, and none at all of the supplementary satellites. There are, however, several measures of the exterior principal satellite, II.

In the memoir of 1788, Sir William gives 44″·23 as the greatest elongation of II from *Uranus* at his mean distance from the earth, and calculates the similar greatest elongation of I to be 33″, *i.e.* from the periodic time and Kepler's law. He considers these to be approximate only. In the memoir of 1815 he uses in round numbers, and for numerical convenience, 48″ and 36″ for the elongations; and he adds a list of selected observations from which more certain values may be deduced; but it does not appear that he performed this calculation. The other elements of the orbits of the two satellites are pretty exact; the position of the planet was very favourable for these determinations. In 1797 the apparent orbits of the satellites were nearly right lines.

As to the supplementary satellites and their orbits, it would appear

---

* This was a 20-foot reflector with the *front view*, and Sir William's usual mounting.

from both memoirs that Sir William did not affect to speak of them with confidence. Though he had no doubt of their existence generally, yet he avowed that "to determine their numbers and situation would probably require an increase of illuminating power." The precision with which their periodic times, &c. are stated by various authorities must not be supposed to rest on any certain foundation, but on Sir William's approximations and shrewd guesses.

Sir John Herschel directed his attention to the satellites of *Uranus* in 1828–1832, and the results are to be found in our *Memoirs*, vol. viii. The situation of *Uranus* was unfavourable, the planet having considerable southern declination. From his own observations, combined with those of his father, Sir John deduced the following periodic times:—

$$\text{I.} = 8^{d}\ 16^{h}\ 56^{m}\ 31^{s}\cdot 3 \qquad \text{II.} = 13^{d}\ 11^{h}\ 7^{m}\ 12^{s}\cdot 6\,;$$

but "of other satellites," he says, "than these two I have no evidence."

M. Lamont, Director of the Observatory of Munich, commenced his observations of the satellites of *Uranus* in 1837. His memoir is printed in our *Transactions*, vol. xi. They relate to the principal satellites, I and II. M. Lamont believes that he once saw what he takes to be 4, the most distant of the supplementary satellites.

The mass of *Uranus* has been found to be,—

$\frac{1}{20008}$, the Sun = 1, by Sir W. H.'s observations

$\frac{1}{24605}$ by M. Lamont

$\frac{1}{17918}$ by Bouvard, from the perturbations of other planets by *Uranus*.

M. Lamont does not consider his results as very certain, since I and II gave somewhat discordant results; but he is of opinion that Bouvard's mass is certainly too large.

The determination of the mass of *Uranus* has become of great and pressing interest since the theoretical researches of MM. Le Verrier and Adams into the apparently irregular motion of the planet, have led to the memorable discovery of *Neptune*.

If we suppose the two planets to be equal, it is clear that the effect of *Uranus* to perturb the motion of *Neptune* will be more sensible than the reciprocal effect of *Neptune* upon *Uranus*, on account of the greater distance of *Neptune* from the sun. The theory of *Neptune*, therefore, must continue imperfect until a correct value of the mass of *Uranus* can be assigned. With this object in view, M. Otto Struve has undertaken a series of micrometrical measurements of the two principal satellites, which he hopes to complete about the beginning of February 1848. But though the planet is now 5° or 6° north of the equator, and therefore far more favourably placed than when Sir J. Herschel pursued his investigations, still the observations are very difficult, requiring steady

images and a perfectly transparent sky. In this unfavourable autumn only fourteen nights have hitherto been sufficiently fine. Generally speaking, the distances of II have been measured as satisfactorily as the angles of position, and only twice or thrice has the object been too faint to be well observed. The reduction is delayed until the series is completed.

When M. Struve had become familiarly acquainted with these two satellites, he turned his attention to their *supplementary* companions. After being twice deceived in measuring a small star instead of a satellite, he saw, on October 8, an object of which he made the following measures in position:—

	h m		°
Oct. 8	11 16	Pulkowa M. T.	Position = 178·7
	18		186·5
	35		178·8
	36		182·3
	42		176·7

An estimate of comparative distance made the distance = 14″·2.

These observations do not, indeed, prove the object to have been a satellite; but the difference between the first and last angles of position, if it had been a star, would, from the motion alone of *Uranus*, have been 9°. The following observations leave no doubt that a satellite was observed:—

1847.	Pulkowa M.T. h m	Position. °	No. Obs.	Pulkowa M.T. h m	Distance. ″	No. Obs.
Nov. 1	9 52	190·5	3	10 4	17·8	4
	10 23	194·0	3			
28	8 31	203·6	6	8 37	17·0	2
	9 48	202·1	4	8 52	16·7	2
Dec. 9	11 28	218·6	4	11 28	13·7	Estim.
10	5 53	180·1	4	6 3	17·0	4
	6 16	182·2	5			

Nov. 1. The satellite better seen than I and II, which are very near each other.

28. The satellite quite as visible as I.

Dec. 9. The images very good, but the observation not sure. The satellite seen by glimpses.

10. The satellite as well seen as II., but fainter than I.

The observations of Nov. 28 shew clearly enough that the object was a satellite; the *position* angle of a fixed star would have been altered 10°.

It may, at first sight, seem odd that *all* the observations are made on the *same side* of the planet. There are, however, many analogous cases among the satellites, if this should always occur. The satellites I and II, for instance, are found to alternate in brightness. There has been, however, no really fine observing night after Oct. 8, on which the satellite could have been observed on the other side.

The observations of this inferior satellite are not sufficiently

numerous to yield an accurate orbit. It may, however, be assumed, pretty safely, that it has been observed near its greatest elongation, *i. e.* that the apparent semi-axis is between 17″ and 18″; in which case it must have a period somewhere about 3 or 4 days.

Now the satellite has, approximately at least, always been observed at the same part of its orbit, and hence the intervals of 24, 27, and 12 days, must, approximately, be multiples of the periodic time. The hypothesis of a period of 3 days, which first presents itself (or more accurately, from the observations of Oct. 8 and Dec. 10, $2^{d}\,23^{h}\,45^{m}$), M. Struve finds wholly incompatible with the observation of Dec. 9, and he prefers a period of 4 days (more accurately, $3^{d}\,22^{h}\,10^{m}$); which, admitting a slight error on Nov. 1, agrees equally well with the observations. This result also accords better with the presumed mass of the planet; for the first period and greatest distance, 17″·5, gives the mass $\frac{1}{15480}$, larger than Bouvard's, while the second period assigns $\frac{1}{26860}$ to the mass, somewhat less than Lamont's, but yet a tolerable approximation to it.

The difference between M. O. Struve's period for this satellite, and that of $5^{d}\,21^{h}\,25^{m}$, assigned to Sir W. Herschel's, is considered by M. O. Struve to be due to an erroneous estimate of the semi-axis. He has no doubt of the identity of the two objects.

After remarking that the foregoing observations completely prove the existence of Herschel's 1st supplementary satellite, M. Struve remarks that the visibility of this satellite depends less upon the aperture of the telescope employed than on the sharpness of the image shewn. All the telescopes, in his opinion, which will shew I and II, are *large* enough to shew 1, if they are *good* enough. It is not fainter than the other two, but, from its greater proximity to *Uranus*, requires better defining power and freedom from stray light.

M. O. Struve has not hitherto seen any other supplementary satellite, but he remarks that the position of *Uranus* is every year becoming more favourable for this inquiry; and there can be little doubt of their speedy rediscovery, so far as they actually exist.

MISS MITCHELL'S COMET.

Observations.

HAMBURG. (M. Rümker.)

1847.	Hamburg M.T.			R.A.			N.P.D.		
	h	m	s	°	′	″	°	′	″
Dec. 11	18	6	34·0	227	55	12·6	98	44	40·5
17	18	7	6·5	229	25	22·0	93	44	17·6
18	17	34	54·4		40	11·7	92	55	49·9
19	18	3	24·7	229	56	5·0	92	5	1·7

Elements. By M. George Rümker.[*]

Perihelion Passage, 1847, November 14·1763.

	°	′	″	
Longitude of Perihelion	274	26	10·8	Eq. Oct. 17.
Node	190	55	55·6	Eq. Oct. 17.
Inclination	72	10	50·7	
Log Per. Dist.	9·5184953			Motion Retrograde.

COLLA'S COMET.

Observations.

Starfield. 20-foot Equatoreal Reflector. (Mr. Lassell.)

1847.	Greenwich M. T. h m s	Comet—Star. R.A. m s	Comet—Star. N.P.D.
Dec. 28	8 37 12·6	+0 30·36	
	8 52 15·5		+2 0·4
30	6 26 9·5	−1 0·90	
	7 7 8·2		+1 14·8

These are instrumental results, uncorrected.

"On Dec. 28 the comet was compared in R.A. with a star *a*, and in N.P.D. with a different star *b*, both of the 9·10th or 10th magnitude. These stars were again compared with a third star *c*, of about 8th magnitude. Assuming approximate apparent place of *c* to be,

R.A. $19^h\,46^m\,33^s$ N.P.D. 35° 43′ 40″[†]

b follows *c* in $1^m\,51^s{\cdot}4$ and is south of *c* 2′ 8″·3

a precedes *b* by $0^m\,32^s{\cdot}7$ and is south of *b* 3′ 28″·8

"On Dec. 30 the apparent place of the star of comparison is approximately,

R.A. $19^h\,55^m\,35^s$ N.P.D. 36° 4′ 30″ (8 mag.)

"No illumination whatever could be used, on account of the excessive faintness of the comet. For the differences in N.P.D. I was obliged to use a somewhat ruder micrometer than Dollond's, and of a different construction. The sky on the 30th was of at least average clearness, yet the comet was almost the *minimum visibile*, with the full aperture of 24 inches."

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[*] A rough ephemeris of the comet for the first half of January, also by M. George Rümker, accompanied these elements, but arrived too late to be of use.

[†] *c* has a close comparison of 10·11 mag.

A Method of Calculating the Orbit of a Planet or Comet from Three observed Places. By Professor Challis.

This method resembles in principle that of Laplace, of which it may be regarded an extension, the object of the author being to include in the calculation differential coefficients of the *third* and *fourth* orders, for the purpose of insuring greater accuracy in the final results. The equations by which the problem is solved are formed as follows. If α and β be the observed right ascension and north polar distance of the body at one of the given times, corrected to a given equinox and given position of the earth's equator, and x, y, z be its co-ordinates at the same time, having their origin at the place of the observer, these quantities are related to each other by the two equations

$$x = y \cot \alpha, \quad x = z \cos \alpha \tan \beta.$$

Each observed place furnishes two such equations. To include parallax the origin of co-ordinates is transferred to the earth's centre. If ϱ be the distance of the body from the earth, and q be the aberration constant, the effect of aberration is taken into account by changing x, y, z respectively into $x - \frac{dx}{dt} q\varrho$, $y - \frac{dy}{dt} q\varrho$, $z - \frac{dz}{dt} q\varrho$. The origin of co-ordinates is then transferred to the centre of the sun, by calculating exactly the sun's co-ordinates at the three times of observation. Thus six equations are formed in which the unknown quantities are the heliocentric co-ordinates of the body. The co-ordinates at the first and last times of observation are expressed in terms of the co-ordinates at the intermediate time, by series including differential co-efficients of the *fourth* order of the latter co-ordinates. The six unknown quantities to be found are then, the heliocentric co-ordinates x_2, y_2, z_2 at the middle time, and their first differential co-efficients $\frac{dx_2}{dt}$, $\frac{dy_2}{dt}$, $\frac{dz_2}{dt}$. A first solution is obtained by including only differential co-efficients of the second order, and neglecting the aberration terms. This conducts to the following values of the co-ordinates,—

$$x_2 = \mathrm{M} + \frac{\mathrm{N}}{r_2^3}, \quad y_2 = \mathrm{M}' + \frac{\mathrm{N}'}{r_2^3}, \quad z_2 = \mathrm{M}'' + \frac{\mathrm{N}''}{r_2^3},$$

r_2 being the body's heliocentric distance. Hence

$$r_2^2 = \left(\mathrm{M} + \frac{\mathrm{N}}{r_2^3}\right)^2 + \left(\mathrm{M}' + \frac{\mathrm{N}'}{r_2^3}\right)^2 + \left(\mathrm{M}'' + \frac{\mathrm{N}''}{r_2^3}\right)^2.$$

For solving this equation, a graphical method given by I. I. Waterston, Esq. in the *Monthly Notice* of the Royal Astronomical Society for December 1845, is recommended. The value of r_2 being

found, those of x_2, y_2, z_2, and their first differential co-efficients, are readily derived, the equations for determining them being linear.

By means of the first approximate values of the unknown quantities, the second order of approximation is proceeded with so as to include differential co-efficients of the third order and the more important aberration terms. The third approximation includes differential co-efficients of the fourth order, and some small additional aberration terms. These approximations are so conducted that the quantities obtained are *corrections* to the first obtained values, and it is consequently not necessary to calculate with seven-figure logarithms.

The values of x_2, y_2, z_2, $\frac{dx_2}{dt}$, $\frac{dy_2}{dt}$, $\frac{dz_2}{dt}$, being thus obtained as accurately as possible, the elements of the orbit are readily derived by known formulæ. As the observed right ascension and north polar distance were not corrected into latitudes and longitudes, the elements are by this calculation referred to a plane through the sun's centre parallel to the earth's equator in a given position. By a simple computation they may be transferred to the plane of the ecliptic. But the original form is the most convenient for obtaining geocentric co-ordinates in terms of the eccentric anomaly, for the purpose of calculating an ephemeris; and also for deriving equations of condition by which the elements may be corrected by future observations. The method of doing this the author proposes to describe at another opportunity.

A brief Notice of the Imperial Observatory of Poulkova.

By the Astronomer Royal.*

The Observatory of Poulkova was built on the plans furnished by its director, M. Struve; the instruments are, for the most part, constructed according to his special instructions. The peculiar scope of this noble establishment is *sidereal* astronomy in its widest sense; and Mr. Airy strongly expresses his admiration of the definiteness of the purpose which M. Struve had in his mind, and of the thorough manner in which it has been carried into effect. He says that "no astronomer can feel himself perfectly acquainted with modern astronomy in its most highly cultivated form, whether as regards the personal establishment, the preparation of the buildings, the selection or construction of the instruments, or the delicacy of using them, who has not well studied the Observatory of Poulkova. To this excellence many antecedent circumstances have

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* The Astronomer Royal visited Poulkova last summer, and gave orally an account of the Observatory at the meeting of the Society in November, the substance of which was communicated in a letter to Professor Schumacher, and printed in the *Astronomische Nachrichten.*

materially contributed: the first of these is the personal character of M. Struve; his mature experience obtained before the intention of building the new observatory had been formed; his vigour in arranging the plans on a large scale, and in superintending constructions even to the minutest point, and his perseverance and skill in arranging the subsequent proceedings of the observatory." The liberality of the Emperor, the freedom of choice as to site, instruments, &c., have been admirably employed by the director. The character of the buildings, in addition to their perfect suitability to their design, is that of splendour without extravagance. The foundations are most carefully laid, and solid beyond any former example.*

The large Equatoreal, by Merz and Mahler, is the instrument which has principally extended the fame of the Poulkova Observatory. The optical part is doubtless admirable, though, perhaps, more control over the adjustment of the object-glass would be desirable; but Mr. Airy was far from satisfied with the rest of the instrument. It did not obey its slow motions in right ascension and declination with promptitude or accuracy, and the clock movement was deficient in power. In short, though in the delicate and experienced hands of M. Otto Struve the telescope is made to yield the utmost of its powers, Mr. Airy does not consider the instrument, as he saw it, a good specimen of mechanism.

The Heliometer, by the same artists, met with much greater admiration; and, indeed, Mr. Airy seems to have been very much impressed with the beauty and excellence of all the other instruments. He goes so far as to say that he considers the meridional observations at Poulkova to be greatly superior to those of any other observatory with which he is acquainted. The Transit and Vertical Circle of Ertel, the Meridian Circle and Prime Vertical Telescope of Repsold, are praised, with some critical remarks, but no serious drawback. Some doubt is expressed whether the Prime Vertical Telescope would, in other hands than those of M. Struve himself, give quite such marvellous results as he obtains from it: still, in Mr. Airy's judgment, a prime vertical telescope is far superior to any zenith sector yet contrived for the investigation of aberration, parallax, &c., or small differences of latitude; and he considers the Poulkova results as leaving all competition far behind.

Mr. Airy "had the pleasure of witnessing complete observations made by M. Struve with the Prime Vertical Telescope, and pays the tribute of his admiration to the caution, the delicacy, the steadily waiting till the proper time, the promptitude at the proper time, which distinguish the director's mode of observing."

The excellence of the levels attached to the instruments at Poulkova, and the successful precautions constantly practised there

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* The Observatory and its instruments may be well understood from the beautiful work published by M. Struve, *Description de l'Observatoire Astronomique Central de Poulkova*, St. Pétersbourg, 1845, 4to. with a volume of plates, which has been distributed most liberally among astronomers.

to avoid error in their use, are particularly noticed. The construction of the Standard Barometer is pronounced to be "admirable," and the noble Library* considered "to be probably the most complete in the world in reference to its peculiar subjects."

On the Transit Instrument at the Bombay Observatory.

By Capt. Shortrede.

Captain Shortrede gives a short account of the instrument, its mounting, &c. before he became acquainted with it. Such mistakes as he relates can scarcely occur a second time, and therefore they may be passed over in silence.

When Capt. Shortrede visited the Bombay Observatory during his trigonometrical operations, he learned that the instrument was considered incurably defective. A full consideration, however, led him to a different opinion; and as he is himself a workman, and from his former connexion with the Mint as assistant-engineer, had great facilities for procuring the best assistance which the country afforded, he undertook the re-erection of the instrument, which, his his own services being gratuitous, would not exceed 300 rupees. This offer being communicated to the Governor, the sum specified was readily advanced.

The stone pillars are two feet square: the upper part of one had been greatly split and shaken by unskilful perforations; and Capt. Shortrede directed the upper 15 inches of each to be taken off. These he replaced by two blocks of Puna stone, which are 18 inches square at bottom, sloping to 12 inches square at top. This size seemed sufficient for steadiness, and was as large as could well be procured at Puna or transported to Bombay. Due care was taken to attach the blocks perfectly to the piers.

The new Y plates were of bell-metal, cast at the Mint, and well and truly worked; particular care was taken that the plate bore truly on the stone near the screw-holes.

The pivots of the axis are supported throughout their length; the motions for every adjustment were found free and without shake. Instead of the usual Y, Capt. Shortrede adopted a collar bearing, which he intended should exactly fit the pivots. The workman, however, made them somewhat large, and, as he finished them by grinding, not quite true. Having no time to get new collars made, Capt. Shortrede had a groove cut out at the bottom of the bearing and at the top of the covering piece, in each of which a slip of wash-leather was secured by lac-varnish. These

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* A Catalogue of this Library has been recently published, ***Librorum in Bibliothecâ Speculæ Pulcovensis contentorum Catalogus Systematicus***, Petropoli Typis Acad. Scient. 1845, 8vo.

do not interfere with the bearing, and they stop the dust before it comes to the bearing. The constant daily shower of sand from the sea-breeze and neighbouring shore would soon destroy any pivot working in the ordinary way, and this consideration suggested the collar mounting, which was intended to be as close fitting as possible. No iron was used in the work, the liability to rust in such a situation makes the material unsuitable.

The instrument thus fitted up continues to work satisfactorily. There are no counterpoises, Capt. Shortrede (luckily perhaps) not having had time to procure them before quitting Bombay.

Letter from Mr. Dawes announcing the Detection of Two new Double Stars.

"On December 12th, 1847, I observed 42 (*c*) *Orionis* to be close double; magnitudes 5 and 9; distance about 1″·8. An elegant object which could scarcely have been overlooked by the Herschels and Struve, if it has not recently come out.

"On January 15th, 1848, η *Orionis* was discovered to be close double; the magnitudes of the components being 4 and 5, and distance 1″. It is a beautiful object of its class, and can scarcely fail to prove a *binary* system. Sir W. Herschel observed this star in 1781, and, on account of a small star distant about two minutes in the n. f. quadrant, entered it as vi. 67. But he did not notice it as close double; neither did Struve at Dorpat. Yet, with a 6-inch aperture, it is now perfectly separable. As, therefore, it may be an object of much interest, the attention of double-star observers is specially requested for it during its present apparition."

Longitude of Port Essington. By Mr. H. Breen, Jun. of the Royal Observatory, Greenwich.

The meridian passages of the moon from which the following longitude is deduced were observed by Capt. O. Stanley, R.N. F.R.A.S. The original observations were forwarded some time ago to the Society by Capt. Stanley, and Mr. Breen recently undertook their reduction, which he has performed thus:—

He first corrected the observations for errors of azimuth and level, the instrument being supposed to be adjusted in collimation. From the transits thus corrected and an approximate longitude, the errors and rates of the mean solar chronometer on the days of observation were computed, and from these data the observed right ascension of the moon was deduced. Mr. Breen then interpolated the moon's right ascension from the *Nautical Almanac* (*Moon-Culminating Stars*) for two assumptions of longitude differing one minute, with fourth differences inclusive; and finally applied the correction which was required to satisfy the observations of Green-

wich, Cambridge, Edinburgh, and Hamburg. The final results are,—

East Longitude, Port Essington.

			h	m	s
1839.	June	20	8	48	69·23
		24			18·24
		25			31·12
	Aug.	19			44·37
		22			40·82
	Sept.	16			55·00
		17			54·10
		18			53·58
		20			51·35
		21	8	48	28·53
	Mean		8	48	44·64 East.

Two observations on June 22 and Sept. 22, which seem to have been noted 1^m too late, are omitted.

Mr. Breen has also furnished the following longitudes deduced from observations contained in the *Monthly Notice* for December 1846.

1. RAINE'S ISLAND. Occultation ν *Aquarii*. July 2, 1844.

East Long. = $9^{h}\ 36^{m}\ 32^{s}{\cdot}86 + 1{\cdot}382\,(x-e) - 1{\cdot}264\,(y-f) + 1{\cdot}897\,n$. Immersion.

= $63{\cdot}77 + 1{\cdot}545\,(x-e) - 0{\cdot}701\,(y-f) - 1{\cdot}729\,n$. Emersion.

2. NEPEAN ISLAND, *Torres Straits*. Occultation λ *Libræ*. March 27, 1845.

East Long. = $9^{h}\ 35^{m}\ 7^{s}{\cdot}45 + 1{\cdot}422\,(x-e) + 1{\cdot}332\,(y-f) + 2{\cdot}013\,n$. Emersion.

3. DARNLEY ISLAND. Occultation ρ *Sagittarii*. May 24, 1845.

East Long. = $9^{h}\ 35^{m}\ 15^{s}{\cdot}40 + 1{\cdot}406\,(x-e) - 0{\cdot}928\,(y-f) + 1{\cdot}746\,n$. Immersion.

x and y are the seconds of space which are to be *added* to the right ascension and north polar distance of the moon in the *Nautical Almanac* to produce the correct place.

e and f are the seconds of space which ought to be *added* to the assumed right ascension and north polar distance of the star.

n is the correction to the moon's semidiameter taken from the *Nautical Almanac*.

The assumed place of ν *Aquarii* is taken from the *Greenwich Catalogue of* 1439 *Stars;* λ *Libræ* and ρ *Sagittarii* from the *Nautical Almanac of* 1845, section *Occultations*.

Self-luminous Spot in the Moon.

On the 11th of December last, at 6 P.M. while Mr. Hodgson, of Fir Grove, Eversley, was observing the dark body of the moon, "a bright spot, about ¼ the angular diameter of *Saturn*, was perceived, which, though it varied in intensity like an intermitting light, was at all times visible." On this occasion Mr. H. used an achromatic telescope of 5 foot focal length, and powers 50 and 80. The bright spot was best seen by the higher power, probably, as he suggests, because the field was smaller and darker, but it was instantly visible to the most uninitiated eye when the bright part of the moon was excluded from the field.

On the following day glimpses of the same spot were caught between passing clouds with a Newtonian reflector; power 40.

From Mr. H.'s sketch, the bright spot is about 5′ below the real northern point and near the following limb.

ERRATUM IN THE PRESENT NUMBER.

Page 36, the sign of the Corr. for Aberr. in N.P.D. must be changed throughout; it was computed for Declination, and not altered.

NOTE.

Copies of the present Notice will be forwarded to many of our Foreign Members and Correspondents in the least expensive manner which can be discovered; but the rules of postage in different countries are so various, and the rates charged by the English Post-office for over-sea letters so exorbitant, that some difficulty is felt as to the best course to be pursued. Information on this point, or assistance, will be very acceptable.

Printed by George Barclay, Castle Street, Leicester Square.

ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *February* 11, 1848. No. 4.

Sir John F. W. Herschel, Bart., President, in the Chair.

The following Report was presented by the Council:—

Report of the Council to the Twenty-eighth Annual General Meeting.

In commencing their Twenty-eighth Annual Report, the Council feel they can truly state that few occasions of the kind have afforded them more satisfaction. The matters on which they have to report will, they have no doubt, speak for themselves in terms which will produce the same feeling in this Meeting.

The Report of the Auditors, subjoined, will shew the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	188	0	3
1 year's dividend on £900 Consols	26	4	4
1 ditto on £2272 7s. 4d. New 3¼ per Cents	71	14	0
On account of arrears of contributions	50	8	0
79 contributions (1847–48)	165	18	0
2 ditto (1848–49)	4	4	0
2 compositions	42	0	0
13 admission fees	23	2	0
11 first year's contributions	14	14	0
Sale of Memoirs	54	14	6
	£640	19	1

EXPENDITURE.

	£	s.	d.	£	s.	d.
Cash paid for Investment of 1 composition				21	0	0
Mr. Barclay, for printing Memoirs				180	5	3
Ditto for printing Monthly Notices				97	4	11
Taxes: Land tax and window duty, 4 quarters	8	7	3			
Taxes: Income and property tax, 4 quarters	1	9	2			
				9	16	5
J. Williams, for 1 year's salary as Assistant-secretary				100	0	0
Ditto commission on collecting £313 10s. 6d.				15	13	6
Carried forward				£424	0	1

EXPENDITURE (*continued*).

	£.	s.	d.
Brought forward......................	424	0	1
Charges on books, and carriage of parcels	3	1	7
Postage of letters	17	7	8
Porter's and charwoman's work	10	17	4
Tea, sugar, cakes, &c. for evening meetings	13	12	0
Coals, candles, &c.	12	18	6
Sundry disbursements by the Treasurer	27	3	2
Balance in the hands of the Treasurer (26th Jan. 1848)......	131	18	9
	£640	19	1

The assets and present property of the Society are as follows:

				£	s.	d.
Balance in the hands of the Treasurer				131	18	9
3 contributions of 9 years' standing	£56	14	0			
3 —— of 8 ditto	50	8	0			
4 —— of 7 ditto	58	16	0			
1 —— of 6 ditto	12	12	0			
1 —— of 5 ditto	10	10	0			
6 —— of 4 ditto	50	8	0			
2 —— of 3 ditto	12	12	0			
7 —— of 2 ditto	14	14	0			
21 —— of 1 ditto	44	2	0			
				310	16	0

£900 3 per Cent Consols.
£2272 7*s*. 4*d*. New 3¼ per Cent Annuities.
Unsold Memoirs of the Society.
Various astronomical instruments, books, prints, &c.

The stock of volumes of the *Memoirs* still in the Society's possession is as follows:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	50	IV. Part 2	178	XI.	261
I. Part 2	95	V.	193	XII.	274
II. Part 1	114	VI.	212	XIII.	296
II. Part 2	80	VII.	238	XIV.	480
III. Part 1	140	VIII.	224	XV.	278
III. Part 2	160	IX.	232	XVI.	340
IV. Part 1	165	X.	249		

It has been judged expedient that this account of the stock of *Memoirs* on hand should in future form part of the Annual Report. It will be seen that the number of complete sets still remaining is not large, and the Council will soon have to take into consideration the propriety of stopping the sale of the earlier volumes. It is obviously desirable that some sets should remain with the Society, for presentation to such important astronomical institutions as may be founded from time to time.

The progress and present state of the Society, with respect to Fellows and Associates, is as follows:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1847	123	127	73	5	328	37	365
Since elected	1	8	...	...	...	...	9
Deceased	−3	−2	−1	−2	...	−1	−9
Resigned	...	−1	...	...	...	...	−1
Removals	...	...	...	...	...	...	...
February 1848	121	132	72	3	328	36	364

The instruments belonging to the Society are now distributed as follows:—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Beaufoy* clock,
The *Herschelian* 7-foot reflector,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,
The Universal quadrant by Abraham Sharp,
The 7-foot Gregorian reflecting telescope (late Mr. Shearman's),

are in the apartments of the Society.

The brass quadrant, said to have been *Lacaille's*,

is in the apartments of the Royal Society.

The Standard scale

is in the charge of the Astronomer Royal, with the consent of the Council, to be employed in the formation of a new Standard Measure, under the direction of the Standard Committee.

The *Lee* circle

is now in the hands of Mr. Simms for some repairs, preparatory to its being returned by Lord Wrottesley.

The remaining instruments are lent, during the pleasure of the Council, to the several parties undermentioned, viz.:

The *Fuller* theodolite, to the Lords of the Admiralty.
The other *Beaufoy* clock, } to the Royal Society.
The two invariable pendulums, }
The *Wollaston* telescope, to Professor Schumacher.
The Variation transit (late Mr. Shearman's), to Mr. J. Rees.

The sixteenth volume of the *Memoirs* has now been published for some time, and the seventh volume of the *Monthly Notices* is also completed. The Fellows will have observed that, for many months past, the *Monthly Notices* have assumed a new and more active character. They have always been effective as a record of the proceedings of the Society, a precursive abstract of all that is in the *Memoirs*, and a place of deposit for much valuable matter which, from its temporary character, could not properly find a place in the larger volumes. But they have lately been something more, inasmuch as they have been employed in calling the attention of astronomers, and particularly of observers, with more both of minuteness and extent, to points of instant importance. For the suggestion of this change, and its conduct hitherto, the Society is indebted to the Rev. R. Sheepshanks, whose services the Council have so often to acknowledge.

The memoir on the longitude of Valentia, which contains an account of operations carried on by the Astronomer Royal for the Admiralty, is printed at the expense of the Government, and by the Government printer. This will explain the difference of type, particularly as regards the numerals, which are of the modern form, while those in the rest of the volume are of the ancient character, of which the Council has done its best to promote the restoration.

The paper by Mr. Adams, "On the Perturbations of *Uranus*," appears in this volume, for which it was originally intended, though, owing to the well-known circumstances which attended its promulgation, the offer of Mr. Stratford to print it as a supplement to the *Nautical Almanac for* 1851 was accepted. To the energetic manner in which Mr. Stratford followed up his proposal, and the personal exertion which he used (greatly as we believe to the satisfaction of the Board of Admiralty), the Council was indebted for the opportunity which was afforded to its Members of seeing Mr. Adams's investigations in detail before they proceeded to their deliberations of January in last year. As circumstances connected with first publication are often misunderstood by lapse of time, it may be as well here to record that this supplement to the *Nautical Almanac for* 1851 was really printed and circulated at the very beginning of last year, though the *Almanac* itself (with its supplement still attached) only made its appearance about a month ago.

In the final superintendence of this volume, the Society is under much obligation to Mr. Galloway, whose acceptance of the Secretaryship this time last year was mainly due to his sense of the difficulty in which the Society might be placed, if a duty which unavoidable circumstances had rendered more than usually pressing were at once to pass into hands unused to its routine. The Council regret to add, that they lose the services of Mr. Galloway in this capacity; but they think the Meeting will feel with them that the presence in the Council of so many persons who have learnt how to serve the Society in the post of Secretary is a very encouraging circumstance, and a guarantee for the effective transaction of its business.

In the Annual Report of last year, intimation was given that the *Monthly Notices* would be considerably modified, and would, in future, include a larger portion of the communications addressed to the Society than had thitherto been usual; and the Fellows are now in a situation to judge of the advisableness of the course pursued. It is hoped that the increased expense of the *Notices* will be more than compensated by the corresponding contraction of the *Memoirs*, and that more complete and more interesting matter will be thus presented gratuitously to the Fellows. It is proposed to print all short memoirs, all observations, all matters of immediate interest, and accounts of inquiries which are in progress, with such details as more directly concern the Society itself, in the *Monthly Notices*, reserving the larger memoirs, and more finished results, for the quarto volume. There will, at times, of course be some difficulty in classing the memoirs; but care will be taken that the general rule of finding a place for every communication of value, and of printing very little twice over, shall be, on the whole, observed.

The Council have directed that the *Monthly Notices* shall be collected and published as a *part* at the end of every session, and that a volume of the *Memoirs* shall also be pnblished annually. The two publications are to be considered as members of the same work, each imperfect without the other.

At present, an attempt to introduce something like uniformity gives a good deal of trouble: very much requires to be re-copied, a loss of labour which would be spared, if contributors would either follow carefully the types already set forth, or would furnish other forms still more complete and adapted to an octavo page. Some errors, too, would thus be avoided, and the printer's charge for corrections be greatly lessened.

The ephemerides of the newly discovered planets have been mostly supplied by Mr. Hind and Mr. Adams. It is not possible that Mr. Hind should continue to render such services to the Society as he has done during the past year, with due regard to himself and to the South Villa Observatory. Yet it is impossible that amateur observers, or even the directors of our public observatories, should be able to follow recently discovered planets, or comets, without at least an *approximate* ephemeris. Here is, then, a task which would be very useful when performed, and in which many of our members could assist. If the Society is to furnish means of observing the recently discovered bodies until they are inserted in the *Nautical Almanac* (and in few ways can it act more beneficially), we must press more amateur computers into the service. Is it too much to ask of the zealous cultivators of astronomy who are with us to-day, bodily or in good will, that they would, so far as they are able, lend their hearty co-operation to this good work? A cursory glance over the recent numbers of the *Notices* will shew what has been effected by a moderate degree of organisation and method, and what may be expected from more vigorous measures. There is a powerful observing force in this kingdom (a force greatly on the increase), competent to contend with the most difficult objects, and directed by

zealous observers. It is for this Society to furnish some of the aids most needed, and to assist in seizing the proper points of application. Nor is our power to help and encourage limited to this country alone. Gratified as we may be with the successful exertions of our corporation and its individual members up to the present time, there is great scope for increased exertion. So extensive, indeed, and varied is the science of astronomy, that any sensible and zealous man may contribute to its progress or its perfection in some way or other, and we may confidently assert that such endeavours would be encouraged and justly valued by the Royal Astronomical Society.

It has been thought advisable to postpone the printing of the Library Catalogue until it should be seen how far the finances of the Society would allow of the additional expense attending a complete, and now not a small, Catalogue. The funds of the Society, though, under proper management, they do not prove inadequate to its ordinary purposes, will not allow of much additional expenditure.

In consequence of the continued neglect of several of the Fellows to pay the arrears due to the Society, notwithstanding repeated notice given, and the suspension of their names in the meeting-room, agreeably to the Bye-laws, the Council has found it necessary to summon a Special General Meeting (to be held at the close of the present meeting), for the purpose of expelling these defaulters from the Society.

Among the personal losses of the Society we have to notice the deaths of two of our Honorary Members, His Majesty the King of Denmark and Miss Caroline Herschel; as well as those of six of our Fellows, Dr. Dealtry, Captain Grover, Dr. Meikleham, Dr. Pearson, Admiral Shirreff, and the Rev. W. Slatter.

CHRISTIAN VIII. King of Denmark, Duke of Schleswig, Holstein, and Lauenburg, was born Sept. 18, 1786. He succeeded his cousin Frederic VI. Dec. 3, 1839, and died at Copenhagen on Jan. 20, in the present year.

On his accession to the throne, he afforded the same liberal patronage to Astronomy which had distinguished his predecessor: this quality, indeed, seems to be almost hereditary in the house of Denmark. The *Astronomische Nachrichten*, a publication which perhaps has done more than any thing else to extend and perfect the science during the last quarter of a century, was maintained by him on its original footing, and, with great judgment, he specially directed Professor Schumacher* to continue his residence at Altona,— a station better suited to an observatory than the capital, and singularly proper for maintaining an active correspondence with a large

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* Professor Schumacher's residence at Altona, besides giving admirable facilities for collecting and distributing intelligence, enables him to act as a channel of communication between Continental Germany and the kindred countries of England and America. This Society has had frequent occasion for the Professor's assistance; and it is given with a readiness which doubles the obligation.

part of the civilised world. He continued, too, the grant of a gold medal to the first discoverer of every telescopic comet; and it is to the zeal thus excited we owe the immense advances which have been made within the last few years in the detection, observation, and calculation of these interesting bodies. An arc of the meridian, which is now in progress, and which is to be carried to Skagen (the northern point of Jutland) was also an object of his munificence. Some time ago, when Professor Hansen had investigated a theory of the moon by methods of his own, the King ordered that the theory should be reduced to tables at his expense. From the progress already made, this valuable and original work may be expected to be completed in about four years, if the funds be continued.

It will be admitted that these are no common claims to the respect of astronomers; and Christian VIII. shewed by undoubted tokens that his patronage of science was a labour of love. He took an interest in its progress, and was anxious to have early information of every new discovery; it was by his own wish that Professor Schumacher corresponded with him on astronomical subjects.

Though it would not become us to enter into political questions, we should scarcely do justice to this accomplished Prince if some mention were not made of his varied tastes and acquirements: geology, mineralogy, conchology, antiquities, and the fine arts had each a share in his attention. His private collection of minerals and shells excited the liveliest admiration among connoisseurs at the meeting of German philosophers in 1846. While in Italy, he ascended Vesuvius, during an eruption, accompanied by Sir Humphrey Davy, and published his observations on the lavas of that mountain in the *Memoirs of the Academy of Sciences of Naples.** He formed about the same time a fine collection of Etruscan vases, purchasing those belonging to the Archbishop of Tarento, and adding to them as opportunities offered. In the *Antiquarian Annals* he gave an account of "*Ancient Relics and Antiquities found at Bornholm.*"† There is also in print a speech which he delivered as President at the Inauguration of the University of Christiana (Dec. 11, 1811). As Prince Royal he presided over the Academy of Arts; and his refined taste and accurate judgment were universally recognised and admired.

Under the title of Protector, he was, while King, President of the Danish Academy of Sciences; and the meetings of that body were held not unfrequently at the Palace, and in his presence.

We are told by one well qualified to judge, that the King's affability greatly enhanced the value of his solid encouragement. Sometimes, indeed, his regard for personal talents and scientific acquirements led him into a pardonable deviation from court etiquette. Shortly before his death, he added, with his own hand, the names

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* *Osservazioni sulla Lava del Vesuvio del 26 Gennajo,* 1820. *Memoria di S.A.R. il Principe Christiano Federico di Danimarca, Socio Onorario dell' Academia delle Scienze di Napoli.* Napoli, 1820, 4to.

† Vol. iv. 1827, p. 379, *et seq.*

of Professors Oersted and Schumacher to the Grand Crosses of the Danebrog—an honour perhaps never before conferred on a professor—saying that he felt great pleasure in being thus able to prove that he considered literary and scientific merit as not inferior to that of any other kind.

Christian VIII. is succeeded by his son Frederic VII., born Oct. 6, 1808.

On the subject of Miss Herschel's astronomical career, the Council feel that they cannot do better than insert, with some additions, an account contributed by our President to a literary journal,* on the recent occasion of her death. The Council always endeavour to procure biographical notices in the most authentic form, and from the most unquestionable sources; and not generally feeling at liberty to alter the words of communications so received, they begin by giving the above-mentioned communication entire.

Miss Caroline Lucretia Herschel died at Hanover on the 9th of January, in the ninety-eighth year of her age. She was the fourth daughter of Isaac Herschel and his wife, Anna Ilse Moritzen, and sister to the celebrated astronomer of that name, as well as the constant companion and sole assistant of his astronomical labours, to the success of which her indefatigable zeal, diligence, and singular accuracy of calculation, not a little contributed. She was born† in Hanover on the 16th of March, 1750; where she resided under the parental roof till her twenty-second year—when she joined her brother, then actively engaged in the musical profession at Bath, in England, a country which was destined to be her home for half a century. There, from the first commencement of his astronomical pursuits, her attendance on both his daily labours and nightly watches was put in requisition; and was found so useful, that on his removal to Datchet, and subsequently to Slough—he being then occupied with his reviews of the Heavens and other researches—she performed the whole of the arduous and important duties of his astronomical assistant,—not only reading the clocks and noting down all the observations from dictation as an amanuensis, but subsequently executing the whole of the extensive and laborious numerical calculations necessary to render them available to science, as well as a multitude of others relative to the various objects of theoretical and experimental inquiry in which, during his long and active career, he at any time engaged. For the performance of these duties His Majesty King George the Third was graciously pleased to place her in the receipt of a salary sufficient for her singularly moderate wants and retired habits.

Arduous, however, as these occupations must appear,—especially when it is considered that her brother's observations were always carried on (circumstances permitting) till day-break, without regard

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* The *Athenæum* of January 22.

† This is 1750 as then called in Germany, where the new style was established. Had it been the English date of that name, it must have been now rendered by 1751.

to season, and indeed chiefly in the winter,—they proved insufficient to exhaust her activity. In their intervals she found time both for actual astronomical observations of her own, and for the execution of more than one work of great extent and utility.

The observations here alluded to were made with a small Newtonian sweeper, constructed for her by her brother; with which, whenever his occasional absences or any interruption to the regular course of his observations permitted, she searched the Heavens for comets,—and that so effectively as on no less than eight several occasions to be rewarded by their discovery (viz. on Aug. 1, 1786; Dec. 21, 1788; Jan. 9, 1790; April 17, 1790; Dec. 15, 1791; Oct. 7, 1793; Nov. 7, 1795; and Aug. 6, 1797). On five of these occasions (recorded in the pages of the *Philosophical Transactions* of London) her claim to the *first* discovery is admitted. These sweeps, moreover, proved productive of the detection of several remarkable nebulæ and clusters of stars previously unobserved: among which may be specially mentioned the superb Nebula, No. 1, Class V. of Sir William Herschel's catalogues—an object bearing much resemblance to the celebrated nebula in *Andromeda*, discovered by Simon Marius—as also the Nebula V, No. 18; the 12th and 27th clusters of Class VII.; and the 45th, 65th, 72nd, 77th, and 78th, of Class VIII. of those catalogues.

The astronomical works which she found leisure to complete were: 1st. *A Catalogue of* 561 *Stars observed by Flamsteed*, but which, having escaped the notice of those who framed the *British Catalogue* from that astronomer's observations, are not therein inserted: 2nd. *A General Index of Reference to every Observation of every Star inserted in the British Catalogue.* These works were published together in one volume by the Royal Society; and to their utility in subsequent researches Mr. Baily, in his *Life of Flamsteed*, pp. 388, 390, bears ample testimony. She further completed the reduction and arrangement as a *Zone Catalogue* of all the nebulæ and clusters of stars observed by her brother in his sweeps: a work for which she was honoured with the Gold Medal of the Astronomical Society of London, in 1828,—which Society also conferred on her the unusual distinction of electing her an Honorary Member.

On her brother's death, in 1822, she returned to Hanover, which she never again quitted,—passing the last twenty-six years of her life in repose, enjoying the society and cherished by the regard of her remaining relatives and friends, gratified by the occasional visits of eminent astronomers, and honoured with many marks of favour and distinction on the part of the King of Hanover, the Crown Prince, and his amiable and illustrious consort.

To within a very short period of her death her health continued uninterrupted, her faculties perfect, and her memory (especially of the scenes and circumstances of former days) remarkably clear and distinct. Her end was tranquil and free from suffering—a simple cessation of life.

So far the account in question. Besides the tributes mentioned

in it as paid to her, it may be added that she was elected a Member of the Royal Irish Academy, and presented with a gold medal by the King of Prussia, as an acknowledgment of her astronomical services. From H. R. H. the Duke of Cambridge, when Viceroy of Hanover, she received great kindness and attention. At her funeral, which took place on the 18th of January, the coffin was adorned with palm branches by order of the Princess Royal, and followed by a royal carriage. Her memory will live, with that of her brother, as long as astronomical records of the last and present century are preserved; and it will live on its own merits, even though, as may reasonably be hoped, the time should come when the astronomical celebrity of a woman will not, by the mere circumstance of sex, be sufficient to excite the slightest remark. It must be matter of congratulation that she survived to see the enormous undertaking commenced by her brother extended and perfected by her nephew.

Dr. DEALTRY's life is written at length in the theological periodicals, and the greater part of it was passed in the active duties of a parish priest, only varied by efforts to promote various objects of religious association. He was of Trinity College, Cambridge, and took his degree of Bachelor of Arts, being Second Wrangler, in 1796, and proceeded Doctor of Divinity in 1829. He is known to the mathematical world by his work on Fluxions, the last of any note which preserved that name and its attendant symbolic notation. This work ranks high among its class. The first and second editions were in 1810 and 1816, and there is a third comparatively recent.

Captain JOHN GROVER was descended from a family in Hertfordshire. He entered the army on August 12th, 1812, as ensign in the 12th Regiment. While on his way to join the forces in Belgium, shortly previous to the battle of Waterloo, the transport which conveyed him was shipwrecked on the coast of Holland, and on this occasion it is recorded of him that he did not leave the vessel till the safety of every individual under his authority was fully secured. Though too late for the battle of Waterloo, he was present at the capitulation of Paris.

He was promoted to the rank of Captain in 1826, from which period he remained on half-pay; but though he did not pursue the path of active military service he was not idle, and he employed the resources of his private fortune in pursuits congenial to his tastes —in cultivating natural history and science: he employed also nearly three years in the study of jurisprudence, and other subjects, at the University of Bologna.

In 1843, the uncertain fate of his friend Colonel Stoddart, and of Captain Conolly, two officers who had gone on a diplomatic mission to the court of Bokhara, and who were reported to have been murdered, caused him great anxiety, and he determined to employ every effort, either to restore them from captivity if they were yet alive, or to ascertain the particulars of their death. Captain Grover

was desirous to proceed at once himself to the scene of their captivity, and he applied to Her Majesty's Government for their permission or countenance to his travelling as a British officer. As, however, they declined to recognise him in any other position than that of a private traveller, and as he deemed some further protection indispensable in an enterprise of peculiar delicacy and hazard, he was obliged to decline the undertaking.

About the same time the Rev. Joseph Wolff, who had travelled in Bokhara and adjacent countries some years before, likewise entertained doubts of the reports in circulation respecting the death of Colonel Stoddart and Captain Conolly, the latter of whom was his particular friend, and resolved to proceed in person to set the question at rest. He obtained from Government the assistance that he required in letters and introductions, and set out on his journey with the confidence founded on his knowledge of the countries and people he had to pass through, and his personal acquaintance with individuals of high rank in Bokhara, and also on the respect which he knew would, in general, be paid to a minister of religion.

In the meantime Captain Grover made every exertion in England to forward the success of the enterprise, and proceeded to St. Petersburgh in order to acquire such information as the Russian Government might afford him, and, if possible, to obtain their cooperation. The object of Dr. Wolff's journey, in obtaining a circumstantial account of the fate of the prisoners, was not indeed fully effected, but no doubt remained that they had been treacherously put to death. Dr. Wolff himself was, as related in the account of his journey, made prisoner by the Khan of Bokhara, and was in great danger of his life.

The unceasing exertions of Captain Grover, and his anxiety, while any hope remained, for the safety of his friend, appear to have been too much for his constitution; he lost his voice, and his strength declined somewhat rapidly until his death, which took place at Brussels on Nov. 6, 1847, in the 51st year of his age.

Captain Grover was a man of very active habits, of benevolent disposition, and of extraordinary perseverance of character. From his taste for arithmetic and habits of order he had been from a very young officer charged with the accounts of the detachment of his regiment which he accompanied. He was a member of several scientific societies, and a constant attendant at their meetings.

Captain Grover was married about 1831, and has left an only daughter.

Rear-Admiral SHIRREFF was a son of the late General Shirreff, and gained the first rudiments of his education in Westminster School. Here, however, his continuance was short, for, having evinced a strong desire for sea life, he was entered on board La Juste, of 80 guns, as a first-class volunteer, in 1796, being then in the 12th year of his age. From this ship he was discharged during the mutiny of the following year; and he afterwards served his probational time as midshipman and master's mate, successively in the Princess

Royal, Neptune, Circe, Stag, Romney, Magnificent, and Reynard. In these ships he was in very active service, and employed on various harassing duties, especially at the blowing up of the sluices at Ostend, the cutting out of many vessels, and the assisting Sir David Baird's army in the Red Sea. While on board the Stag frigate, then commanded by the late Admiral Winthrop, a Fellow of this Society, she was unfortunately wrecked in Vigo Bay; and the Magnificent, of 74 guns, of which he was master's mate, was totally lost on the Black Rocks, near Brest, when he narrowly escaped being made a prisoner.

On the 3rd of March, 1804, Mr. Shirreff was promoted to the rank of lieutenant, in which situation having served two years, he was advanced to that of commander; and in these posts he served four years in the West Indies with great zeal and credit. As captain of the Lily sloop of war, he acquired the public approbation of his admiral by his conduct at the capture of Deseada, and his protection of it afterwards.

Captain Shirreff was posted into the Garland, of 22 guns, on the Jamaica station, on the 15th of November, 1809. His next appointment was in October, 1812, to the Barossa, a new 38-gun frigate, in which ship he proceeded to North America, where he was actively employed till the conclusion of the war; when, being paid off, he passed a few years with his wife and family. In the autumn of 1817, however, he was called upon to commission the Andromache, of 44 guns, for the South American station; and he remained nearly four years senior officer in the Pacific Ocean, where his upright demeanour greatly forwarded the interests of British commerce in very troublous times. While thus employed, he at his own risk freighted a small vessel, and sent her with his barge, under the command of Mr. Edward Bransfield, master of the Andromache, to examine and survey certain lands reported to have been seen to the southward of Cape Horn; and to this voluntary responsibility we owe the correct appearance of South Shetland on the charts.

Returning home from South America in August 1821, Captain Shirreff retired to domestic life; and having joined this Society, then newly formed, he became much interested in its objects, insomuch that he built and equipped a small private Observatory, the principal instruments being a clock, a portable transit, a 12-inch altitude and azimuth circle, and a 5-foot telescope. He had ever been very attentive to nautical astronomy, and was what is called among naval officers a smart lunarian. From these pursuits he was diverted in January 1829, by his appointment as flag-captain to Rear-Admiral Baker, the commander-in-chief on the South American station, whose flag was hoisted on board the Warspite, 74. Finding, however, the season very trying to his health, he invalided, and returned to England in 1830.

After a short repose, his health being fully restored, he again sought active employment, and was Captain of the Port at Gibraltar for seven years and a-half; and such was the insight which he gained of Spanish interests, that he was sent on a confidential

mission to Madrid by Lord Palmerston, to aid in fixing the foundation of a new commercial treaty. While at the Rock, he kept an observatory at his own expense, for the purpose of giving the exact time to shipping; and owing to his earnest recommendation, a light-house was erected on Europa Point. He was recalled to England, and appointed Captain-Superintendent of Deptford Dockyard, where he remained from April 1838, to August 1841; during which period he was usefully employed in carrying strict economy into that establishment. When the Astronomer Royal instituted his successful experiments on iron-built ships, for the purpose of discovering a correction for the deviation of the compass produced by the iron of the ships, Captain Shirreff rendered such cordial co-operation, that in the admirable memoir of the proceedings published in the *Philosophical Transactions* for 1839, Mr. Airy thus expressed himself:—"To all the persons named above my cordial thanks are due for the zeal and steadiness with which they followed out my plans under the most distressing circumstances of weather. But to Captain Shirreff in particular an acknowledgment of my obligations must be here given. Not only was the assistance of men and materials from the Dockyard furnished by Captain Shirreff in the way which I thought most desirable, but by his presence and by the interest in the operations which he displayed, the services of all the subordinate persons were rendered fully efficient; while the part which he took as an active observer, from the beginning to the end, materially lightened my labours, and increased my confidence in the results."

From Deptford, Captain Shirreff was removed to the more important Dockyard at Chatham, which he actively presided over till November 1846, when he obtained flag-rank as Rear-Admiral of the Blue. On the 1st of September last he was appointed Admiral-Superintendent of Portsmouth Dockyard, and entered upon his duties with his usual zeal and ability. But his health, which had been greatly shaken by his various services, had been in a declining state for a considerable period; he bore this, however, so well that none but his intimate friends were at all aware of the extent to which he suffered. On the 30th of November he expired of an effusion into the lungs, at his official residence, in his 63d year. Having died in command, his remains were honoured with a public funeral on the 8th of December, being interred in the Military Garrison Chapel at Portsmouth, attended by all the civil, military, and naval authorities, under the usual ceremonials. In him the service lost an excellent and strict officer, the community a polished gentleman, and this Society one of its early and active members.

The Rev. William Pearson, LL.D. F.R.S. F.R.A.S., &c. Rector of South Kilworth, and one of the Board of Visitors to the Royal Observatory of Greenwich, was born at Whitbeck, Cumberland, on the 23d April, 1767. He was educated at the grammar-school of Hawkshead, and is said to have very early shewn a

strong liking for mechanism. While residing at Lincoln he constructed a portable clock (still in the possession of his family), which shewed the phases of the moon in conjunction with the ordinary time. He contrived and executed various machines for exhibiting and explaining astronomical phenomena, among which are mentioned various planetariums, and an exemplification of the system of *Jupiter*. Finally, he constructed "a large Orrery with equated Motions," of which there is a description by himself in Rees' *Cyclopædia*. He made too, with his own hands, an altitude and azimuth instrument, which is now in the possession of Mr. Patrickson, his nephew.

In 1811, Dr. Pearson became the proprietor of a celebrated establishment at Temple Grove, East Sheen, where many of the nobility and gentry received their preparatory education. Here he built an observatory and furnished it with instruments.

In 1817, Dr. Pearson was presented by Lord Chancellor Eldon to the rectory of South Kilworth, Leicestershire, where (after quitting Temple Grove in 1821), he constantly resided. An observatory was at first arranged in a new wing to the rectory-house, but he ultimately erected a detached observatory on a considerable scale, and at a convenient distance. Here he set up the principal instruments which he had collected, and employed a permanent assistant, whom he carefully trained in observation and computation.

Dr. Pearson contributed very largely to Rees' *Cyclopædia*, having furnished, as we believe, *all* the articles which relate to practical astronomy and to the mechanical construction of timekeepers, telescopes, instruments, orreries, &c. These extend to sixty-three separate contributions, illustrated by 110 plates, which must have given him considerable occupation during the years 1806–1818, when the work was in progress. Probably he derived considerable assistance from his intimate friend Troughton, as well as from Tulley, Hardy, &c., all most eminent artists at that time in their respective callings; still he must have relied mainly on his own practical skill as a mechanician, and on his own personal acquaintance with the tools and methods of astronomy.

In 1824, Dr. Pearson published the first volume of his great work, *A Treatise on Practical Astronomy*, in two large 4to volumes. This first volume consists chiefly of tables, most of which were computed specially for the work under the author's direction. It is dedicated to the President, Vice-presidents, and Members at large, of the Astronomical Society. In 1829 the second volume appeared, dedicated with great propriety to his intimate friend, the distinguished artist Troughton. In this volume Dr. Pearson communicated not merely descriptions of instruments, but whatever his long practice had taught him of precautions in observing, or methods of reduction. At the present time, so great has been the advance of astronomy in the last twenty years, the *Treatise on Practical Astronomy* must rather be considered a book of reference than one of routine and direction. It will always continue to be of great value, and is necessary as a commentary and illustration of this branch

of our science during the generation just past. This laborious and costly work was published at the expense of the author, with a certainty of great pecuniary loss.

When the establishment of an observatory at Cambridge was proposed on the grandest scale, and at an outlay greatly beyond the means of the University, Dr. Pearson contributed fifty guineas in aid of that spirited design.

He was appointed a Visitor of the Royal Observatory of Greenwich by Mr. Davies Gilbert, then President of the Royal Society, when the Board of Visitors was remodelled; and so far as his health permitted, he was a regular attendant on their meetings.

Dr. Pearson retained his mental faculties and bodily strength to an advanced age, though suffering occasionally from attacks of gout. He died at South Kilworth on September 6, 1847. He was twice married, and left an only daughter by the first marriage; the second Mrs. Pearson survives him.

Such are the principal events of Dr. Pearson's scientific life which we have been able to collect. He outlived most of his contemporaries and familiars, or undoubtedly more particulars might have been gathered with profit, and related with interest. To the record of his exemplary professional life as a clergyman and magistrate, we can scarcely be considered parties.

All mention of Dr. Pearson's connexion with the Astronomical Society has been hitherto omitted, in order that it might be presented at once. Unfortunately, even here, there is some uncertainty, which we are not at present able to clear up.

It seems highly probable, that to Dr. Pearson we owe it that an Astronomical Society was founded. Existing documents prove that he took steps to originate such an institution so early as 1812, and that in this laudable attempt he was assisted by Mr. Troughton, Dr. Kelly, and others, whom we find among our earliest and warmest supporters. In 1816 this proposal had taken so much consistency, that Dr. Pearson, at the request of his coadjutors, wrote a preparatory prospectus and address, which were, he says, submitted to Lord Erskine, probably with a view to obtain his lordship's countenance and influential aid.

The documents in our possession do not enable us to trace the origin of the Royal Astronomical Society further back than January 12, 1820. On that day a meeting was held at the Freemasons' Tavern, which agreed unanimously to constitute themselves into a society for the cultivation of Astronomy,* to circulate an Address

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* There are two accounts of this meeting, a printed circular, and the MS. minute-book. There is a little difference in form, but not in substance, between the two. The circular ran thus:—

"*London, Jan.* 12, 1820.

"AT a meeting of several scientific gentlemen, held this day, to take into consideration the propriety and expediency of establishing a Society for the encouragement and promotion of ASTRONOMY, it was unanimously agreed to form themselves into a Society for that purpose, to be called the *Astronomical Society*

explanatory of their objects, and to invite the co-operation of such persons as were inclined to join their body.

The Address was written by Sir J. Herschel, and is entitled, "Address of the Astronomical Society of London," with the date, "January 1820." It will be found in the beginning of the first volume of the *Memoirs*. Sir John Herschel recollects that Dr. Pearson was active in pressing this service upon him.

On February 8th, the Astronomical Society met at the house of the Geological Society, according to appointment, and assented to the Rules and Regulations (see *Memoirs*, vol. i. pp. 9–20) which were proposed by the Committee: Dr. Pearson was appointed Treasurer *pro tempore*.

At the adjourned meeting of February 29th, the officers of the Society were elected, and Dr. Pearson was confirmed as Treasurer.

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of London; and to frame a set of rules and regulations for their government and future proceedings.

It was then resolved,

1. That a Committee of eight members be appointed to draw up such rules and regulations; and that three be a quorum.
2. That C. Babbage, Esq. F.R.S.; F. Baily, Esq. F.L.S.; Capt. T. Colby, Roy. Eng. LL.D. F.R.S.E.; H. T. Colebrooke, Esq. F.R.S.; O. Gregory, LL.D.; I. F. W. Herschel, Esq. F.R.S.; D. Moore, Esq. F.R.S. S.A. and L.S.; and the Rev. W. Pearson, LL.D. F.R.S., be the committee above mentioned.
3. That a general meeting of the Members take place on Tuesday, Feb. 8th, at the house of the Geological Society in *Bedford Street, Covent Garden*, at 7 o'clock in the evening *precisely;* to take into consideration the rules and regulations which may then be proposed by the Committee.
4. That any person (recommended by one of the present members of the Society) who may be desirous of joining the Society at, or prior to, the above-mentioned general meeting, shall (on previously signifying in writing his assent to these resolutions, or on authorising a member by letter to signify the same on his behalf) be considered a member thereof without ballot.
5. That the Committee be authorised to draw up an ADDRESS, explanatory of the motives and object of the Society; and to circulate it in such manner as they may think fit.

"FRANCIS BAILY, Secretary *pro tem.*"

The Minute-book gives the names of all those present; states that they met by appointment, and that, before any other business, they signed the following mutual agreement:—

"At a meeting held this twelfth day of January, 1820, at the Freemasons' Tavern, London, to take into consideration the advantages that are likely to result from the establishment of a Society for the cultivation of Astronomy, we, whose names are hereunto subscribed, being fully aware of the utility of such an institution, do hereby mutually agree to constitute ourselves a society, to be called the Astronomical Society of London, and to be guided in our future proceedings by such rules and regulations as may be formed for such Society, in the manner to be appointed at the present meeting for that purpose."

Then follow the resolutions, and at the end there is a memorandum, "That it was omitted to be stated in its proper place that D. Moore, Esq., was unanimously called to the chair." Until the election of officers, Mr. D. Moore, and Mr. F. Baily, acted as chairman and secretary.

This meagre account is all that can be confidently presented as vouched for by existing documents in the possession of the Society. There is nothing to shew by whom the meeting of January 12th was called, but it is said to have been resolved upon at a dinner-party given by Dr. Pearson at East Sheen, and mainly at his suggestion.* It is clear, that the first proposal of an Astronomical Society proceeded from Dr. Pearson; that this proposal was kept steadily in view by him and agitated for several years; and that he was one of the earliest and most zealous members when it was actually constituted. He continued in office as treasurer for more than ten years, and resigned on June 11th, 1830, when his non-residence in London, and increasing age, made his attendance at the Council too onerous.

A specimen of flint-glass was presented to the Society in 1823, by M. Guinand, of Neuchatel, which, with a disc of English plate, was worked into an object-glass of $6^{\text{in}}\cdot 8$ aperture, and 12 feet focal length, by Mr. Tulley. After careful examination (see *Mem. Ast. Soc.* vol. ii. p. 507), the Council offered this object-glass to sale by public tender, the overplus, after Mr. Tulley's charge for working was paid, being designed as a remuneration to M. Guinand. On this occasion, Dr. Pearson alone made a tender, and his liberal offer of 250*l.* was accepted. If we are right, this was at that time the largest object-glass in England, though it has since been greatly surpassed by object-glasses imported from the Continent, and by the works of our own opticians.

The gold medal of the Society was awarded to Dr. Pearson in 1829, for his *Treatise on Practical Astronomy*, when the complimentary address was delivered by Sir John Herschel, at that time President. The unsold copies of this valuable work have been for one or two years stored in our apartments, and were bequeathed by the author to us, along with the illustrative copperplates.

The Society's *Memoirs* contain several contributions from Dr. Pearson. It is understood that he left a Supplement to his "Catalogue of Stars within 6° of the Ecliptic," in considerable forwardness.

We regret that this notice of a member who has borne so large and so influential a part in the Royal Astronomical Society should be, as it is, manifestly imperfect, and we hope that additional infor-

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* Some of the surviving original members have been consulted, and their impression seems to be that Mr. Baily had the principal share in the actual foundation of the Society. There is much internal evidence of his management in the business-like course pursued on February 8th; and however the Society may have originated, he was the chief agent in carrying out the idea vigorously and effectively. The minute-books of the Council, of the ordinary meetings, and of the general meetings, are all in Mr. Baily's handwriting, up to the vacation in 1822. But though it may appear clear that, from the first attempt at a union, Mr. Baily took that share of the actual details which he never relinquished, it must not be forgotten that Dr. Pearson was the first to whom it suggested itself that a Society for the promotion of Astronomy was needful and practicable, and was the first who attempted to impress that conviction upon others.

mation may yet be afforded from the recollections or inquiries of our members.

In the last Report the Council recapitulated the proceedings which had taken place with respect to the proposal of a medal for the researches which led to the discovery of the planet *Neptune.* The result was, that differences of opinion with respect to the relative places of M. Le Verrier and Mr. Adams, and the action of the bye-laws provided for such cases, prevented any medal from being awarded. A long and earnest discussion ensued in the last General Meeting upon this negative decision of the Council, for the general tenor of which it is sufficient to refer to the various amendments which were proposed on the question of printing the Report, as given at the end of that document. The result was, that a resolution was carried to the effect that a Special General Meeting should be called to consider of the propriety of suspending the bye-laws relative to the medals, and authorising the Council to award two or more, as might seem fit. The intention was simply to enable a new Council to come to a fresh discussion of the question, without the restrictions which had theretofore made a necessary alternative of the exclusion of one or the other of the two names which are immortalised by connexion with the discovery.

This Special General Meeting was held on the 12th of March. In the meantime it had become apparent, not only that the differences of opinion above alluded to would exist upon any measure which could be proposed, but that they would be likely to produce very serious effects upon the working power of the Society. The necessity of harmony in administrative bodies upon points which are held to contain and announce important principles, is too well known to need proof here; and the number of active supporters of astronomy, possessed of leisure to devote to the business of this Society, is not large enough to allow of an entire Council being chosen by the General Meeting, out of the supporters of one side only of a serious division of opinion. Under these circumstances, the Council could come to no other conclusion than that it was their duty to recommend the Society not to proceed further in the matter: and this course was warmly advised by those of every opinion on the disputed questions. And upon hearing the state of the case, the General Meeting almost unanimously concurred in the same view; and a resolution, to the effect that no further steps should be taken, was carried. The Council remembers with great satisfaction the amicable tone in which the above differences, more serious than any which had ever prevailed in the Society, were discussed at the meetings; and they feel assured that in no public body can the prospect of disunion arising out of divided deliberation be smaller than in ours.

When the time approached for the proposal of a medal for the present year, it became evident that astronomical progress, for the time being, was in a state very different from that in which the framers of our bye-laws found it. At the time when this Society

obtained its charter, it was a circumstance not unfrequently remarked upon that there was a comparative paucity of great things, accompanied by a constant and gradual improvement of routine. Results of remarkable thought, as well as those of remarkable toil, though not wanting, were not abounding as in the days of William Herschel and Laplace; and we were not without those who prophesied that astronomy had nearly reached its resting-place — that the care of our generation and those who should come after us must be to keep the tools of our forefathers in good order, without seeking, or at least without finding, the means of new invention. Though this extreme opinion was far from having ground to stand upon, it may be admitted that the bye-law which restricted the Council to the award of one medal in each year produced no striking inconvenience for many years together. Recently, however, the number of proposals has somewhat increased: and those who were present at the Council in January last could not but admit that the propriety (if one medal only were to be granted) of postponing all claims to those of Messrs. Le Verrier and Adams, obvious as it might be, was accompanied by the full knowledge that there was an unusual number of well-supported claims to postpone. It cannot, therefore, fail to be seen that this circumstance, coupled with the open state in which the medal question of last year had been left, was likely to place the Council in a position of very serious embarrassment.

Fortunately, however, the difficulty increased to such an extent, as, by its own magnitude, to become no difficulty at all. The completion of various astronomical labours of the most distinguished character has marked the course of the year 1847; and the discovery of no fewer than three planets has rewarded two most skilful and assiduous observers. Several members of the Council began to feel that the notion of discriminating between claims so various in character, so well supported in circumstances, so unequivocal in merit, so unexpected in number, must be abandoned — that the epoch must be recorded, as well as the individual men to whom its peculiar glory is due. It seemed as if Astronomy had exhibited the results of every kind of human aid, and had chosen the year 1847 to shew how well she could at once command the highest speculations of mathematical intellect, the laborious perseverance of calculating toil, the discriminating sagacity of the observer, the munificence of mercantile wealth, and the self-devotion of the voluntary exile. An opinion was pretty generally agreed in, almost as soon as first expressed, that something of a more comprehensive nature than any practicable award of medals was demanded by the existing circumstances; and it was felt that a Testimonial, including those to whom those very recent additions to our knowledge were due, would be a proper tribute, as well to them as (if we may say it) to the period which they have rendered so remarkable.

With this feeling existing, it was proposed at the meeting of the Council in November, and on the subject of the medal arriving in due course, that the several Members should propose their candi-

dates for the medal, just as if an intention existed of proceeding to the selection of one in the usual manner. The following names, here taken in alphabetical order, were put forward in answer to the proposal: — Mr. Adams, for his inverse application of the theory of perturbations; Mr. Airy, for his voluntary reduction of the ancient lunar observations made at Greenwich; Mr. Argelander, for his catalogues of stars; Mr. Bishop, for his foundation and maintenance of an observatory which has enlarged the solar system; Colonel Everest, for his completion of the meridian arc measured in India; Mr. Hansen, for his additions to our knowledge of the lunar theory; Mr. Hencke, for his discovery of two planets; Sir John Herschel, for his astronomical labours in the southern hemisphere; Mr. Hind, for his discovery of two planets; Mr. Le Verrier, for his inverse application of the theory of perturbations; Sir John Lubbock, for his researches in the theory of planetary perturbations; Mr. Weisse, for his zeal in the reduction of observations of stars.

On a review of this list, it speedily became apparent that it did not include a name which might not be most worthily added to the list of medallists with which the Society is able to honour its successive volumes of *Memoirs*, and which would not be so added if it stood alone. The plan of the Testimonial was, therefore, resolved on: that is to say, the Council, looking on the proposal as that of a *bonâ fide* departure from the bye-laws relating to the medals, resolved to apply to the Society for power to deliberate upon the proposal. This was done at a General Meeting convened for the purpose on the 10th of December, and the power applied for was granted by an unanimous vote of that meeting. The end was, that the plan was adopted at the meeting of Council held on the 14th of January.

In regard to this Testimonial there are two points which the Council think it necessary to mention. It is confined strictly to astronomical services completed within a recent period — to matters which might reasonably have been expected to have been under ordinary discussion for the medal of 1848. It is impossible, therefore, the Council trust, that they shall be held to undervalue any of the great things which have been done for astronomy by the same or other men at other times. Secondly, no idea of any comparison between those included in the list has been for a moment entertained. A look at the reasons of the various awards will shew that no such idea could possibly have been entertained. The merits, for example, of Mr. Adams and M. Weisse (to take a name from each end of the alphabetical list), are wholly distinct in species, though each are great of their kind. The same is to be said of those whose labours more resemble each other; and in particular, of those of M. Le Verrier and Mr. Adams. Had this been the first occasion on which the Council brought these two names before you, it would have been necessary either to enter on a critical examination of the question which they have referred to history, or to make a somewhat laboured, and perhaps unsuccessful, attempt to shew that the

testimonial thus jointly awarded involved no opinion, and justified no inference on the comparative rights of the two. But after the discussions of last year, the Council is fully satisfied that not you only, but the astronomical public of Europe, will understand their proceeding in its true sense; namely, that these distinguished names are placed together in the same sense and manner as those of Sir John Lubbock and M. Argelander, or those of Mr. Airy and Mr. Bishop; that is, just as though the merits admitted of no more comparison as to homogeneity in the first pair of cases than in the second or the third.

The Testimonial decided upon has been an inscription, handsomely printed on vellum, of which the following is a copy:—

"In recognition of the great advances recently made in astronomy, and in gratitude to those who made them, the Royal Astronomical Society has awarded this public Testimonial to certain distinguished astronomers, among whom is *A. B.*, whose [*here the services are briefly stated*] place him among those who have greatly contributed to the progress of human knowledge, and who is hereby most respectfully requested to accept and preserve this acknowledgment of his talent, energy, and success."

And the Council, in awarding this Testimonial, in place of and in the same rank with the usual medal, desires the receivers of it to be assured that, in their opinion, the honour of bestowing it does not fall short of that of receiving it, though the merit of appreciation is not equal to that of desert.

The Council has requested the President to undertake the usual office of addressing you on the specific and several services for which the Testimonial is given. But as his own name is in the list, they are obliged, no matter how far their description may fall short of what he could have done for another, to offer a few words, and but a few, on the grounds which have determined their vote in his case; not in the way of formal justification, for that is needed neither here nor elsewhere, but rather in justice to themselves, and as having a right to shew that they are not behind others in their perception of his eminent contributions to astronomy. At the same time, the position in which Sir John Herschel stands to us, and his actual presence among us, make the Council think it right to say less than they might otherwise feel pleasure in saying.

It is hardly necessary to remind you that four years and part of a fifth, beginning with 1834, were passed by Sir John Herschel at the Cape of Good Hope, with the avowed, and now happily completed, object of extending to the southern hemisphere the plan of observation which had been exhausted in the northern, with unity of instruments, methods, and purpose. The results of this labour are now published in a splendid volume, at the expense of the present Duke of Northumberland, in fulfilment of an offer made by the last holder of that ancient title, the munificent donor of the Cambridge Equatoreal. To an expression of respect for the memory of this truly enlightened nobleman, and of gratitude to his worthy successor, the Council feel that they may be permitted to

add one of congratulation. The number of great houses in Europe exceeds by hundreds to one the opportunities of connecting their histories with works like the present.

Sir John Herschel's undertaking is well known to have been determined, in the first instance, by a resolution to follow the track which his illustrious father had opened. Whatever of personal interest may have been created in the subject during its pursuit—and this cannot have been small—the original motive was of a character which must command respect, independently of all simply astronomical considerations. Without any infringement of the claims of the pursuit which we are here met to promote, we may admit that it was fortunate for astronomy that the love of science was reinforced by this strong inducement of a distinct kind. To the united effect of both we owe the degree and quantity of the exertions which have done for the two hemispheres what it would have been admirable that one head and one instrument should have done for either alone.

The manner in which the researches made in the southern hemisphere have been conducted, so far resembles that adopted in the northern, that no general sketch could be useful as to the former, while the latter are so widely known. Nevertheless, this volume, though it carries in its title a specific reference to the southern hemisphere, contains matters of conclusion and of observation which belong to both. Such are the details on the law of distribution of nebulæ and clusters; and such are the new and valuable researches on the apparent magnitudes of the stars taken in sequences of observations, with a studied connexion of the different sets; such are also the observations of and discussions on Halley's Comet. But from these results, striking as they are in themselves, the mind returns to the consideration of the great whole which has thus been completed. The entire surface of the heavens surveyed in these details which most require unity of natural eye and artificial help, and not only surveyed but measured—the records of this enormous labour carefully reduced and clearly presented—the intellectual conclusions of this vast mass of thought worked out with the patience which is not seen and the sagacity which is — demand a notice which even the presence of the observer, calculator, and discoverer, will hardly restrain within the usual limits of personal eulogium.

The inhabitants of the Cape of Good Hope have marked their desire to perpetuate the memory of the astronomer's sojourn among them, by placing an obelisk on the precise spot occupied by the reflecting telescope ; a monument which, remembering the difficulty lately experienced in fixing the exact locality of Lacaille's observations, will be judged to combine astronomical utility with the gratification of the good and right feeling which suggested the erection. But the Council cannot help hoping that this second visit has happened in better times than those of the celebrated Frenchman : and that its best and most lasting record will be written in the impulse given by it to the cultivation of all sound and liberal knowledge.

The Council have this day gratified you and themselves by the acknowledgment of many different kinds of astronomical merit: but they confidently appeal to you, and all those who can venture an opinion, whether in the case now before them any one of these different kinds of merit is wanting? The well-known power of mathematical invention, the accuracy of the experienced observer, the laborious perseverance of the reducer, the skill of the practised mechanist, the suggestive faculty of the experimental philosopher, have met in one person with the graphical skill which usually marks the finished artist, and the power of language which is so necessary to the success of the poet. To these we are to add the liberal sacrifice of private means, and the devotion, to this part of the work alone, of twelve years of man's short life, several of which were passed in a distant region. And, having mentioned the sacred motive which urged Sir John Herschel to the first undertaking, the Council will briefly allude to the fact, known to themselves, that but for attention to the comfort of another parent, it might have been sooner completed. And as briefly will they express their respectful admiration for another person, whose willing assent to the plan, and untiring endurance of its attendant exile, must have been no small element of its success. To Lady Herschel, who furnished her part of the moral strength of this memorable expedition, a share in the honours of the conquest is justly due, and gladly paid.

The Council will, of course, refer you to the President for some detail on several matters which otherwise would have found their place in this Report. They proceed with their general notice of the progress of the Society and of the science.

The choice of Associates has hitherto depended, as to first proposals, on the motion of individual Fellows of the Society. It has appeared to the Council to be desirable that such method should be introduced into the first proposition as already exists in the subsequent stages of the election. With this view it has been referred to a Committee to consider whether it would not be desirable, without lessening the right of proposal which already exists, to cause a yearly or other periodical presentation of names to be prepared by a committee appointed for that purpose. The object is to secure a proper attention to the names of rising astronomers, independently of the casualties of individual suggestion. A Report made by the Committee, and received by the Council only this day, recommends that the names of several astronomers be added to the list of Associates, and the usual proposal will be suspended in the meeting-room for each of these names.

The Solar Eclipse of 1847, October 8, which was annular in parts of Austria, Italy, France, and England, was expected with great anxiety, as likely to give important information on those curious phenomena attending the internal contact of the sun's and moon's limbs, which, since the publication of Mr. Baily's observations of the eclipse of 1836, have excited so much attention. In

England, the Astronomer Royal, remarking that it was doubtful whether the eclipse would be annular at Greenwich, had (with the assistance of the Rev. G. Fisher, Mr. Riddle, Mr. J. Riddle, Mr. Baillie, and by detaching assistants from the Royal Observatory, using also the subordinate assistance of a number of intelligent and skilful lads of the Greenwich Hospital Schools,) equipped in the most perfect manner four stations to the north of Greenwich (the northernmost being Chingford in Essex), and three stations to the south of Greenwich (the southernmost being Hayes in Kent). At none of these was the eclipse seen at all during its annular phase. In France, the Bureau des Longitudes despatched M. Mauvais and M. Goujon to Orleans, a station on the edge of the annular track, and this expedition was perfectly successful. In Italy, the Observatory of Padua being situated almost exactly on the southern limit of annularity, as Greenwich was on the northern, M. Santini had (by arrangement with the Astronomer Royal) prepared for observations on a series of stations in his meridian; but here the eclipse was not seen. Accounts of the observations have been received from Styria (where it was seen by M. Schaub), and from other places. The statements in regard to the visibility of Baily's beads are very discordant: some of the observers declare that nothing was seen except projections corresponding to visible mountains of the moon, while others think that the appearances which they saw tend to support Mr. Baily's descriptions.

It will be remembered, that some time ago Sir John Herschel (in communicating Mr. Griesbach's series of drawings of solar spots) called the attention of astronomers to the desirableness of collecting unbroken series of graphical descriptions of the sun's surface. The Council have much pleasure in announcing the receipt, from the Rev. J. T. Hussey, of a most excellent addition to the above store, consisting of 1100 drawings of the sun's surface, from April 1826, to December 1837. Some account of this work will appear in the usual manner, but the Council cannot help here expressing, with their gratitude to Mr. Hussey, their hope that his example will be followed.

Since the last Anniversary of the Society five Comets have been discovered.

The first was found by Professor Colla, at Parma, on the evening of May 7. It was always faint, and visible only with powerful telescopes. Two comets only, of the 180 that have been calculated, viz. those of 1729 and 1747, have perihelion distances greater than Colla's. M. Littrow observed it pretty regularly till the middle of November; but we have observations from Professor Challis and Mr. Lassell in December. A parabola satisfies the whole series of observations very well.

On July 4th, M. Mauvais detected a comet not far from the pole, which was very generally observed till October. It exhibited a stellar nucleus, and at one time a short tail. The orbit is greatly

inclined to the ecliptic. This comet is the third discovered by M. Mauvais.

On July 20, M. Brorsen, assisting at Professor Schumacher's Observatory at Altona, made his third cometary discovery. Clouds prevented regular observations until the 21st. M. Rümker followed it until the morning of September 13th. It was soon ascertained that a parabola would not represent the observations, but there are considerable discordances between the elliptic elements that have been computed. M. d'Arrest gives a period of twenty-eight years, while other calculators make it more than a hundred, each conclusion depending on three positions only. The whole series of observations has not yet been fully discussed.

M. Schweitzer, Director of the Observatory at Moscow, discovered another comet near ι *Cassiopeiæ* on the night of August 31st. It was meridionally observed at Altona several times during the month of September, but was never visible without the telescope.

The next comet was discovered independently by Miss Mitchell, in America, on October 1; by De Vico, at Rome, on the 3d; with the naked eye at Cranbrook, by the Rev. W. R. Dawes, on the 7th; and by Madame Rümker at Hamburg, on the 11th. When brightest it resembled a star of the 4th magnitude with unassisted vision, but in the telescope it appeared as a large diffused nebulosity, and on one or two occasions exhibited a tail about 2° in length. It approached pretty near the earth. The perihelion passage took place in the middle of November, but, owing to the great south declination of the comet, it was lost sight of in these latitudes about October 18th. The observers at the Collegio Romano recognised it again on its return from the southern hemisphere, early on the morning of December 10th.

On the 1st of July last, M. Hencke, the discoverer of *Astræa*, detected another small planet with the assistance of Bremiker's Chart for the seventeenth hour of right ascension. At this time it resembled a star of the 9th magnitude, but speedily became fainter and was generally visible as a ruddy star of the 10th magnitude. At the request of the discoverer, Professor Gauss named the planet, deciding upon *Hebe*, with a cup for the symbol. The observations of *Hebe* are pretty numerous. Her period appears to be longer than *Vesta's*, but not so long as that of *Juno*.

The planet *Iris* was discovered by Mr. Hind at Mr. Bishop's Observatory, on the evening of August 13th, in following up a systematic examination of the heavens which had been commenced some months previous. There being no star on Wölfer's Map, Hora xix. of the Berlin Charts, in the position of the planet, and Mr. Hind having looked over that part of the heavens several times during June and July, its nature was very soon decided, and the discovery was announced generally to astronomers in this country next day. It was observed at Cambridge on the 14th, and at Greenwich on the 15th. The observations made both in this country and on the Continent are very numerous. The time of revolution appears to

be nearly the same as that of *Vesta*, perhaps a few days longer. Professor Gauss has recently published the limits of a zodiac for *Iris*, which will probably assist in discovering any former observations of the planet that may exist in the works of Lalande, Bessel, or others. *Iris* has generally equalled in brightness a star of the 8·9 magnitude. The symbol adopted for this planet is a semicircle to represent the rainbow, with an interior star and a base line for the horizon.

On the night of October 18th, another small planet was detected by Mr. Hind, at Mr. Bishop's Observatory, near the star Bessel v. 48, of Weisse's Catalogue, with which it was compared. At the time of discovery it was not very far from its stationary point. During the month of November it equalled in brightness stars of the 8th magnitude, but at present it is a little below the 9th. The elements of this planet, which has received the name of *Flora* on Sir John Herschel's proposition, have already been determined with a considerable degree of accuracy. There appears to be no instance on record where the orbits of various astronomers for a planet or periodical comet have agreed so well together: the values of the mean daily motion in the several orbits do not differ more than 2″ or 3″, and the other elements are very accordant. The period of revolution of *Flora* is shorter than that of any other of her companion planets. The symbol adopted for her designation is the figure of a flower. Observations of the planet will be practicable for some months longer, and an ephemeris, extending to May 1, is given in the last number of our *Monthly Notices.*

After an honourable service of between thirty and forty years, the principal Greenwich instruments are found insufficient for the present demands of astronomy. The Observatory, as is well known, does not enjoy a very clear atmosphere, and the optical power of the transit and circle telescopes is quite unequal to the satisfactory observation of the newly discovered planets, and of the small stars which are so frequently wanted as points of comparison for extra-meridian observations. For these reasons the Astronomer Royal has proposed (and the Board of Visitors has seconded his proposal) to purchase the finest object-glass of 12 feet focal length, and not less than 8 inches' aperture, which can be had. This he intends to mount as a transit circle, and so make the observations in R.A. and N.P.D. with the same instrument at the same time. His opinion is, that by the use of a stouter and tougher material than hammered brass, and, by a better construction, he can get a far stiffer transit than the present one (the excess of length will only be 2 feet), which can scarcely be doubted. He is also of opinion that more reliance can be placed on a circle all in one piece than in one composed of so many parts as the mural circle, notwithstanding the skill of the best workmen has been tasked to the uttermost in its fabrication, that the connexion between the telescope and circle will be less liable to suspicion than it is at present, and that the clamping apparatus, &c. will be far less ob-

jectionable. The graduation may be equally perfect, and the reading microscopes more firmly secured and more uniformly illuminated than they are now. However bold these opinions may at first sight appear to us who have long admired the Greenwich transit and circles, we are certain that while no one is more competent to form a correct opinion on the subject-matter than Mr. Airy, the honour of the Royal Observatory is so dear to him that he will act with due deliberation. Some great practical advantages will clearly result from the substitution of one instrument for two: there will be no observation in right ascension, for instance, without a corresponding observation in north polar distance — a circumstance which sometimes occurs, and is particularly troublesome and vexatious; a single observer, too, will be sufficient for a complete observation, a great relief to a small staff when the weather is baffling or the hour unseasonable.

The zenith tube, from which so much was expected, has not justified expectation. The late and present Astronomer Royal have exhausted all the means which suggested themselves for its amelioration; but, after all, the results are scarcely equal to those of the mural circle. The situation is inconvenient to the family of the Astronomer Royal, and is unsuitable to the instrument: on these grounds, the Visitors have acquiesced in its removal. Perhaps, when it is more satisfactorily placed, *i. e.* in a room where the temperatures above and below are not excessively unequal (and such a one Mr. Airy has found), much of the present irregularity may disappear, and the instrument be finally of use, instead of a mere drag on the Observatory, as it is now found to be.

The Report which we have to make of the progress of the Standard Scale is not altogether satisfactory. There has been much delay, which may be partly accounted for by the non-residence of the experimenter, and by those checks which always occur from bad health or other causes, when only a nice workman and an experienced hand can be employed. But, besides this, some anomalous discrepancies have presented themselves, the causes of which are only just discovered; if, indeed, they *are* now discovered. Some months ago it was remarked, that when two similar bars of the same metal and similarly supported were compared, the results of the series made in the course of the same day, perhaps on following days, agreed most satisfactorily—the probable error of one day's comparisons scarcely exceeding 0·00001 of an inch,— but that, when a considerable interval had elapsed, or when any change had been made in the position of the bars, &c., the results of other series, equally accordant among themselves, would shew a great change in the absolute difference. Thus, the result of very accordant observations at one time, would differ from the result of equally accordant observations at another time, as much as $\frac{1}{6000}$ or $\frac{1}{7000}$ of an inch. This could not arise from expansion, in its ordinary mode of action, for the bars were either of the same metal, or the expansion was allowed for. In all these instances the com-

pared bars must have been nearly at the same temperature, and very little exposed to any change. On considering the matter, no reasonable cause could be assigned for these extravagances by Mr. Sheepshanks and Mr. Simms, or by the Astronomer Royal, who was consulted; except, perhaps, that the illumination might be in fault, or that the points of support might not always be precisely the same, or sufficiently free. Neither cause seemed likely; the light was necessarily thrown down at a definite angle, and, granting that the supports of the bar might act somewhat irregularly, it was by no means obvious how that could affect the length of the central axis of the bar, on which the divisions are marked. Some modifications, however, which have been lately made in the illuminating apparatus, shew that considerable variations in the bisections *may* arise from this cause; and at present it seems not unlikely that, when the light is better arranged, a greater accordance in the results may be obtained. A more perfect support for the bars is also preparing, and in a short time it is hoped that a solution, more or less complete, of the present difficulty, will be obtained. All the ulterior work has been ascertained to be of easy execution.

Among the numerous contributions to Astronomy during the past year, your Council is particularly bound to notice the Reduction of the *Histoire Céleste*, and of the Southern Catalogue of Lacaille, which have been calculated at the expense of the British Association, and published with the liberal aid of Her Majesty's Government. As most of those present (all who are practical observers) know these volumes experimentally, we need not point out their obvious utility for times past and future as well as for the present. But we may remark with satisfaction, that the principal promoter of these valuable works was Francis Baily, who also directed and superintended, up to the time of his death, the preparation of the *Histoire Céleste;* that Professor Thomas Henderson undertook the charge of Lacaille's Catalogue; that our late Assistant Secretaries, Messrs. Hartnup and Harris, performed most of the calculations; and that when the premature deaths of three of these gentlemen had left both catalogues incomplete, they were finished and given to the world by Lieutenant Stratford, aided by the counsel of Sir J. F. Herschel. It is not often that instances occur of so much able and gratuitous co-operation, supplied by the members of one society.

In the last Annual Report an account was given of the progress in the construction of the Altitude and Azimuth instrument intended for the Royal Observatory of Greenwich; an instrument to the erection of which we attach considerable importance, not only because in its construction greater attention is given to the principles of firmness and of union of parts in the same metal than was ever given before, but also because the adoption for daily use of such an instrument, expressly intended for more frequent observation of the moon, marks clearly the policy which is likely to direct

the future proceedings of our National Observatory. We have now to report that this instrument is mounted, and in regular and efficient work. In respect to the increase in the number of observations of the moon, we are enabled, by information received from the Astronomer Royal, to furnish the following statement: — From 1847, May 16 (the first day of use of the instrument), to December 31, the number of days on which the moon was observed with the new instrument was 127, while the number of days on which the moon was observed with the meridional instruments was only 70. When it is considered that a great part of the additional observations were made in portions of the moon's orbit in which meridional observations never could be made, it will be evident that this increase is, in reference to the lunar theory, of the very highest value. On every day of observation (with the exception of only two or three), two azimuths and two altitudes of the moon, in opposite positions of the instrument, have been obtained; on some days, a considerably larger number. In regard to the accuracy of the instrument, as all the star-observations of 1847 are reduced, we can make the following report:—The observations of zenith distance have never given the smallest difficulty; and there is no doubt that, from the first, they are nearly or quite as accurate as observations with the mural circle. It is in the observations of azimuth, as anticipated by the Astronomer Royal, that some difficulties have arisen. The first of these were, discordances to a great extent in the zero point of azimuth. After a careful consideration of every possible cause of error (an inquiry which was very much facilitated by the confidence in the firmness of the instrument consequent on the peculiarity of its construction), it was concluded that the discordances were occasioned by the use of too powerful counterpoises for relieving the pressure of the pivots of the vertical circle. The counterpoises were reduced by one-third, and the discordance disappeared. The next difficulty was in the determination of the value of the level-scales, a difficulty which was more strongly felt in the long levels applying to the correction of azimuth than in the shorter levels required for the zenith distance. After different attempts at correction, it was determined to mount the glass-bubbles in Y's, in the same manner as in the best German levels: this has been done, and the levels now appear free from error. There still remains a small occasional variation of azimuth zero to the amount of about 3″ or 4″, of which it is difficult to assign the cause: it may arise from a small twist of the brick pier, or it may arise from a small disturbance of the transit instrument by the use of which the clock times are converted into sidereal times, or it may arise from a variation in the personal equation of the observer. In its effects it is unimportant, as the nature of the combination of the observations will eliminate the effect (supposed constant for the same day) on the place of the moon. The observations of the moon are not yet entirely reduced.

The transfer of the Edinburgh Observatory to the Government, which is in process of adjustment, and still more, the repairs of the building, which have occupied a much longer time than was expected, have put obstacles in the way of that institution. It is hoped that every thing will be again in working order in June next. In the meanwhile, a portable transit, for time, has been erected in an outhouse, in the new manner proposed for the larger one, namely, on a cast-iron stand, without any adjusting screws; and its bearings have given great satisfaction by their permanence. The volume of observations for 1841, made during the direction of Mr. Henderson, will appear almost immediately; and that for 1842, perhaps in May.

In the last Annual Report an account was given of the progress made by Mr. Maclear in the verification of La Caille's Arc of Meridian, in the Cape colony, and in the extension of it, both ways, to terminations in localities more favourable for eliminating the disturbance of mountain masses than those adopted by La Caille. The northernmost point which Mr. Maclear had then reached (a point on the Kamies Berg), though greatly preferable to La Caille's station at Klyp Fontein, was not wholly unexceptionable. Mr. Maclear, therefore, with the full approval of every person who examined into the subject, determined on extending the measurement to a station about one degree further north, on the extensive plain called the Bushman Flat, near the Orange River. The astronomical part of the operation was completed in the last summer, and in July 1847, Mr. Maclear, having undergone personal hardship and difficulties of every kind almost unprecedented, returned to the Observatory for permanent residence. Bradley's zenith-sector, with which the differences of latitude were determined, was returned to the Observatory in September; and it was Mr. Maclear's intention immediately to take steps for the verification of its divisions, and for observation at the Cape Observatory of the stars which had been observed at the Bushman Flat. The geodetic part was not quite finished, Mr. Montague being still fixed on the Kamies Berg, waiting for the opportunity to measure some horizontal angles. The whole extent of the arc is now about 4°½. We congratulate the lovers of physical science on the near prospect of the termination of this work. The anomaly presented by La Caille's measure had been one of the most puzzling difficulties in the theory of the figure of the earth, and it was incumbent on us to shew that we, in possession of the colony, could display as much zeal in verifying the measure as was exhibited by a foreign visitor in making it. The value of this verification has been *infinitely* increased by the extension now given to the arc.

In the meantime, the proper interests of the Observatory have not been neglected. The principal part of the stars of comparison with Mauvais' second comet have been observed, and their places, in the hands of M. Plantamour, have already done good service. At the date of the last reports from Mr. Maclear, he had mounted

(upon a polar axis, sent from the Royal Observatory of Greenwich) a good telescope belonging to the Cape Observatory. He was also looking anxiously for a 6-inch equatoreal of M. Merz's fabrication, which was despatched from this country in November last. We may now look for a regular series of observations, both meridional and extra-meridional, such as, under the peculiar circumstances of the locality, may be judged most valuable to the interests of astronomy.

The seventh volume of the *Oxford Observations* will soon be published. The work has been recently confined mostly to observation of circumpolar stars. About four-fifths of those in Groombridge's Catalogue have been observed, and about one thousand others. No extra-meridional work has been attempted. Mr. Repsold holds out hopes that the heliometer will be finished in the course of the present year; the many modifications which he has thought it advisable to make in preceding forms of construction has occasioned the delay.

On the Cambridge Observatory Professor Challis makes the following remarks, in a letter to the Secretary. The Council have already advocated the principle here announced, and have much pleasure in giving the extract:—

"After conversation with the Astronomer Royal, I have fully come into an opinion which he strongly advocates, that in the present state of astronomical science it is important to attend to a division and distribution of labour. Meridian observations of the planets, and observations of the moon, are so completely taken care of at Greenwich that it would be comparatively useless to prosecute them here, whilst equatorial observations are nowhere attended to in an equal degree. I propose, therefore, to direct the force of this observatory more especially to equatorial observations, and, in particular, to those requiring the use of a powerful telescope. Already I have partly acted on this plan, by taking observations of the newly-discovered planets about the time of quadrature, when they are no longer visible on the meridian, and by pursuing them as long as the power of the telescope, or their proximity to the sun, will allow. These observations are intended to aid in perfecting the theories of these new bodies."

The Equatoreal for the Liverpool Observatory is advancing very rapidly to its completion, and will soon be in its proper place. Some delay has arisen from an oversight in casting the base at first with an insufficient depth of metal, but this has been repaired. The object-glass is of eight inches' aperture by Merz, and the mounting, which has been prepared under the immediate direction of the Astronomer Royal, promises, in firmness and convenience, to surpass the constructions hitherto adopted. In the meantime, Mr. Hartnup has been devoting his spare time to perfecting the chronometer balance, in which he believes that he has succeeded. It is well

known that the best-made chronometers of the usual construction can be made to keep the same rate at any two given temperatures, but that the rate changes at an intermediate temperature, and at temperatures beyond the given temperatures, higher or lower. Messrs. Eiffe, Molyneux, Dent, &c., have attacked this difficulty (which is, indeed, a very serious one in long voyages, when the timekeepers are exposed to great varieties of climate), and by various methods. Mr. Hartnup has proposed a different construction, and some chronometers, furnished with the new balance, have performed very satisfactorily. He intends, with the permission of the Astronomer Royal, to send some to Greenwich for examination.

The contributions received from unprofessional astronomers during the past year have been numerous, and of great value. The merits of Mr. Bishop and Mr. Hind are the theme for another portion of this Notice in the President's speech.

The instruments of the Observatory of Markree are of the highest class. The equatoreal refractor is, we believe, the largest refractor in use after those of Poulkova and Cambridge, U.S.; and the meridian circle is probably not inferior to any instrument of its kind. The proprietor, Mr. Cooper, has found a most able and zealous assistant in Mr. Graham.

At Makerstoun, Sir Thomas Brisbane has an observatory in full activity, but it is principally directed to magnetism and meteorology. The equatoreal, however, which is a first-rate instrument, has been usefully employed by Mr. Welsh in comparing the newly-discovered faint planets with neighbouring stars, under Mr. Broun's immediate superintendence.

The Durham Observatory is directed by Professor Chevallier, but as his university engagements are too engrossing to leave much time for the practice of astronomy, Mr. Thompson has been engaged as an assistant. This observatory has a transit circle (which is a better instrument, perhaps, for determining right ascensions than north polar distances), and an admirable equatoreal, an original Fraunhofer, of six inches' aperture.

Mr. Dawes is pursuing his observations of double stars at Cranbrook; he has sent some occasional observations and remarks.

The American Observatories of Washington and Cambridge, U.S., have contributed several valuable sets of observations: the Continental observers, whose communications have been received and published, are too well known to require particular notice.

The *Notices* of the past year contain so many and such interesting communications from Mr. Lassell, that it is scarcely necessary to do more than allude to them here. The discovery of the satellite of *Neptune*, the final observations of Colla's Comet, those of the satellites of *Uranus*, and of the interior satellite of *Saturn*, shew that the personal skill and instrumental means of Mr. Lassell

place his Observatory at Starfield in the same line with the Imperial Observatory of Poulkova, or the State Observatory of Cambridge, U.S. It must not be forgotten that Mr. Lassell has to struggle with a very indifferent atmosphere and somewhat delicate health; that the construction of the instrument is *original*, the large mirror, the *work of his own hands*, aided by machinery of his *own erection*, and placed in a building *of his own architecture*;* that he has had *no assistance* of any kind, and not much sympathy nor countenance, except from this Society and its members: besides all this, he is necessarily engaged in conducting a laborious and harassing business.

Among the Communications which have been received by the Society since the last Annual Meeting, is one by our Associate, Professor Hansen, on two inequalities in the motion of the moon. No equally important addition has been made to physical astronomy during many years. For more than half a century the want of a small correction to the moon's theoretical motion, of the nature of an inequality of long period, had been recognised by physical astronomers. Several conjectural terms had been suggested, adopted for a time, and finally disproved. Professor Hansen has shewn clearly that this correction is given by the introduction of two terms, depending on the perturbations which the action of *Venus* produces in the motion of the moon. One of these arises from a remarkable numerical relation between the anomalistic motion of the moon and the sidereal motions of *Venus* and the earth; the other is an indirect effect of an inequality of long period in the motions of *Venus* and the earth, which was discovered some years ago by the Astronomer Royal. The systematic nature of the research made by Professor Hansen for the discovery of terms of this class seems to exclude the possibility that any other similar inequalities of appreciable value will be hereafter found. As an instance of careful and orderly inquiry into the effects produced by forces of a very complicated kind, of application of refined methods to the computation of the results, and of ultimate success, this investigation by Professor Hansen may be compared with any in modern physical astronomy.

Our distinguished Associate, M. Le Verrier, has occupied himself with the question of the identity of comets of short period discovered within a few years with comets observed in preceding centuries. An oral communication on this subject was made by M. Le Verrier at the meeting of the British Association in Oxford in the last summer, and copies of a written paper have been printed in the *Comptes Rendus* of the French Academy, and in the *Astronomische Nachrichten*. A manuscript copy of the same paper was

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* The *plan* of this machinery is taken from that of the Earl of Rosse, but with an important modification by Mr. Lassell. In a letter just received he announces improvements which bid fair to restore the reflecting telescope to its old rank as an astronomical instrument.

transmitted by the author, as a mark of friendship and respect, to this Society; and only the accidental absence of the Astronomer Royal (to whom it was immediately entrusted) prevented an exposition of its contents from having been sooner laid before the Society. The first of these inquiries related to Faye's Comet; and the special question is, Whether Faye's Comet of 1843 is identical with Lexell's Comet of 1770? M. Le Verrier's method of treating this question possesses the following important peculiarities: first, that, taking the best modern observations of the comet, one of them is supposed liable to an error (expressed by a symbol), and the effect of this error upon the elements of the comet is retained in every following calculation; secondly, that, starting from these modern elements (in preference to the ancient ones), the path of the comet is traced backwards, and its perturbations are computed backwards, to the earlier observations. The conclusions at which M. Le Verrier arrives are, that Faye's and Lexell's Comets are not the same; and that Faye's Comet has certainly been a periodic comet at least from the year 1747, or that it had completed at least thirteen revolutions before its discovery. In a subsequent paper, the motions of De Vico's periodical Comet of 1844, August 22, are treated in a similar manner, and the conclusion is that it is probably the same as the comet of 1678.

While directing attention to the advance of Sidereal Astronomy during the past year, we must not omit mention of a remarkable paper by Mr. Galloway, recently published in the *Transactions of the Royal Society*, on the Proper Motion of the Solar System. This subject had been most elaborately treated by Argelander, Lundahl, and Otto Struve, by a comparison of the observed motions of stars in the northern hemisphere with their precessional motion during a long interval. The conclusion arrived at by these astronomers was, that, independently of the proper motions attributable to the stars themselves, there is also an apparent motion well recognised, arising from the set of the solar system towards a well-determined point in the heavens. Mr. Galloway thought this a subject of sufficient importance to induce an attempt at the verification of the fact by a similar discussion derived from observed motions of stars in the southern hemisphere. The ancient observations for this purpose are supplied by the catalogue of Lacaille, recently published by the British Association, and the modern from the catalogues of Johnson and Henderson. Though the observations of Lacaille are not comparable in accuracy with those of Bradley, yet the observed motions of the stars employed so far exceed the probable errors of the observations, that they afford abundantly sufficient data for the purpose. The whole number of stars selected from the catalogues of Johnson and Henderson for comparison with Lacaille is 65, and for comparison with Bradley 16, and these furnish 81 equations for the determination of the proper motion. Mr. Galloway makes no hypothesis with regard to the way in which the apparent or visible motions of the stars are

modified by their real proper motions, nor with regard to their actual distances from the solar system; and in the latter particulars he differs both from Argelander and Otto Struve, the former of whom derives their distances from consideration of their apparent proper motions, and the latter from the consideration of their apparent magnitudes. By a rigorously precise treatment of the equations, a result is arrived at agreeing very satisfactorily with that deduced by Otto Struve for the position of the apex of the sun's proper motion, and therefore adding greatly to the certainty of the fact, and rendering it as sure as that of any of the other phenomena of astronomy.

Researches like the present, laboriously conducted by individuals, are not only honourable to their authors, but they give us the satisfactory assurance that we are prepared to take the next great step in our knowledge of the universe by vigorously applying the abundant materials which are year by year accumulated by means of the labours of our public observatories.

The theory of precession has now met with that revision, through the labours of the Struves and of Peters, that the precessional motion of stars for long intervals may be looked upon as one of our best-ascertained elements; and perhaps it would not be undesirable, for our ulterior advancement, that each published catalogue should contain a comparison of the epochal places with those derived from Bradley's and Lacaille's catalogues, or, which amounts to the same thing, that the apparent proper motion for each star should be computed on a uniform system from the best elements, as a necessary appendage to the catalogue. This would enable astronomers to deal with these residual phenomena without that previous irksome and severe labour which is at present necessary, while it would at the same time establish beyond suspicion that datum on which all other researches must altogether depend, viz. the actual amount of the observed motion.

A remarkable work on the Distribution of the Stars has been published by M. Struve, under the title of *Etudes d'Astronomie Stellaire*. The treatise bearing this name contains an epitome of the whole of the author's views upon this subject, but the details of some of the investigations are to be found in his Introduction to Weisse's catalogue. The first part of the work contains a condensed statement of the opinions of writers preceding W. Herschel (Copernicus, Galileo, Kepler, Huyghens, Wright, Kant, Lambert, Michell), bringing to the knowledge of modern astronomers a quantity of very curious literature, with which in general they are little familiar. The memoirs of Herschel are next reviewed; and the change in the views of Herschel, between the publication of the first and the last of his essays on the construction of the sidereal system, is strongly insisted on. M. Struve then proceeds to explain his own investigations; and, first, in regard to those founded upon the number of stars in Weisse's catalogue (or in Bessel's zones, of which that catalogue is the representative). Weisse's catalogue applies to a

zone of the heavens extending from 15° south declination to 15° north declination, and crossing the milky way at an angle of about 60°. The number of stars in this catalogue, under the divisions of 1 to 6 magnitude, 7 magnitude, 8 magnitude, and 9 magnitude, have been ascertained for every hour of right ascension. But it is not possible that observations taken in the manner of those for Bessel's zones can include every star which is visible in the telescope; and attempts are made to correct these numbers in the following manner:—First, as far as Piazzi's catalogue extends (or to the 8th magnitude): the scales of magnitude having been reconciled, and the number of stars in Piazzi separated under the divisions defined by magnitude (as above mentioned) having been ascertained, and the number of these same stars included in Weisse's catalogue having been ascertained, it is assumed that the proportion of Piazzi's stars included by Weisse (for each step of magnitude and for each hour of right ascension) may fairly be taken as the proportion of all the stars in the heavens (for the same steps of magnitude and the same hours of right ascension) included by Weisse. This proportion is called the *plenitude* of the catalogue; it varies with the magnitude (being smaller for the smaller stars) and with the right ascension (being smaller where the stars are more dense). Secondly, for stars of the 9th magnitude, for which the number of stars in Piazzi is too small to justify the use of the same method. The author here remarks that, in the system of observation of Bessel's zones, the contiguous zones overlapped by a known extent, sometimes in declination, sometimes in right ascension. For these overlapping parts we have therefore tracts of the heavens which have been swept twice or oftener, and we are able to ascertain how often the same stars have been picked up in the repeated sweepings. From these numbers we can infer what is the probability that any given star will have been picked up in the zone observation: this probability is supposed to apply to all the stars which pass the telescope; and thus from the number of stars recorded as observed we deduce the number of stars which have actually passed the telescope. On collecting the numbers obtained by these two methods, it appears that for all magnitudes the stars are most frequent in the neighbourhood of $6^h\ 40^m$ and $18^h\ 40^m$ right ascension, and are least abundant for $1^h\ 30^m$ and $13^h\ 30^m$ of right ascension. This constitutes the first part of the inquiry.

The second part is founded upon the number of stars in Herschel's star-gauges. The process here is simply that of selecting the gauges which correspond to the same zone between 15° south declination and 15° north declination. Upon collecting these, it appears that the parts of greatest and least density for the stars visible only in Herschel's telescopes (or which, when most abundant, constitute the milky way) correspond precisely to the parts of greatest and least density for the stars visible to the naked eye and to smaller telescopes, although the proportion of inequality of densities is much greater. And the conclusion seems irrefragable,

that the stars which we see with the naked eye are a part of the great stratum of stars which, when we see it edgeways, we distinguish as the milky way.

The author then proceeds to investigate, in an algebraical form, the law of the density of stars. Upon remarking the irregularity of the milky way, and the irregularities in the grouping of the stars generally, it will readily be seen that such a law can only be approximate, and can only apply to the mean of densities extending over a great number of similar regions. He naturally proceeds on the assumption that the law of density, if there be an approximate law, must refer to the angular distance of the stars from the general plane of the milky way (which Sir John Herschel happily denominates the Galactic Declination) as argument. Assuming, then, the pole of the galactic equator to be in $12^h\ 38^m$ right ascension and 31° 30′ north declination, and selecting a great number of W. Herschel's gauges at the angular distances, 30°, 45°, 60°, 75°, 90°, from this pole, and assuming that these shall be represented by the law

$$\frac{A + B\cos 2\phi + C\cos 4\phi}{1 + \beta\cos 2\phi + \gamma\cos 4\phi}$$

where ϕ is the galactic declination (a law for the form of which good reasons can be given, it being remarked that any appearance which approaches to that of a stratum seen edgeways requires for its formula an expression containing $1 + \beta\cos 2\phi +$, &c. in its denominator), the coefficients A, B, C, β, γ, are numerically determined. To this point the theory is merely an algebraical expression of the mean of observed numbers.

The next step is very important. Assuming that the distribution of stars is (roughly speaking) uniform in each plane parallel to the galactic equator, and having the algebraical law for the number of stars visible in Herschel's 20-foot telescope, and assuming also that the stars (generally speaking) are not very unequal in size, and that they can be distinguished as stars in Herschel's telescope to a certain distance and no farther, it is possible, from the algebraical law of the number of stars visible, to infer the algebraical law of the density of stars in space at any distance from the galactic equator which is less than the reach of Herschel's telescope. The law is accordingly found and numerically expressed by M. Struve; and among the remarkable conclusions is this, that the density at the distance from the plane of the galactic equator expressed by the reach of Herschel's telescope is barely $\frac{1}{200}$ of that very near to the galactic equator.

A similar process is then gone through for inferring the law of distribution from the number of stars in Weisse's catalogue (corrected, as has been stated), as far as the 7th magnitude and as far as the 8th magnitude. To make the results comparable with the former, it is necessary to have the means of comparing the distance of stars of the 7th and 8th magnitude with the reach of Herschel's telescopes. This is done by comparing the number of stars to the

7th magnitude, of stars to the 8th magnitude, and of Herschel's stars, visible in the central parts of the milky way (a counting which requires a peculiar correction, as no great number of stars can be counted without going beyond the limits of the milky way); and then, assuming the distribution of stars close to the galactic equator to be sensibly uniform, the distance of the utmost stars of those classes will be proportional to the cube root of the number of stars. Thus it is found that the distance of stars of the 7th magnitude is about $\frac{1}{16}$, and that of stars of the 8th magnitude about $\frac{1}{10}$, of that of Herschel's extreme stars. Introducing these values into the results for density, as depending on linear distance from the galactic equator, obtained from the stars of those classes, they are found to agree well with the results obtained from Herschel's stars.

M. Struve then discusses the relative distances of stars of various magnitudes, as inferred from the number of visible stars. It will be sufficient here to cite, that the most distant stars visible to the naked eye are nearly 9 times as far off as an average star of the first magnitude, and that Herschel's most distant stars are at 228 times the same distance. From this last number most important conclusions are drawn in the next section.

That section treats of "the extinction of the light of stars in passing through the celestial spaces." It is well known that Herschel made numerous experiments on the quantity of light reflected from speculum-metal—that he also measured the pupil of the eye (which he estimated at $\frac{1}{5}$ of an inch); that from these he inferred the proportion of the light received from his reflecting telescopes to the light received by the naked eye, and that (assuming the intensity of light to diminish as the inverse square of the distance, and that the general size of the stars is uniform) he inferred that the distance of the utmost stars visible in his telescope bore to the distance of the utmost stars visible to the naked eye the proportion expressed by the square root of that proportion of lights; or that the telescope stars were 61 times as distant as the naked-eye stars. A curious correction (based on experiments) is made for this number by M. Struve, on the following grounds. The best eye cannot adapt itself to accurate vision so well as an eye armed with a telescope; and M. Struve, by the use of a telescope admitting no more light than the naked pupil would admit, found that the number of visible stars was nearly doubled. After due correction for this, it was found that the number which Herschel ought to have inferred from his photometric experiments, as expressing the proportion of the distance of his utmost telescope stars to the distance of an average star of the 1st magnitude, is 664; but the number found above, from countings of the stars, is 228. How are these two numbers to be reconciled? M. Struve considers that there is no other way than by supposing that light is extinguished in its passage, or, in other words, that the law of the diminution of light is not exactly that of the inverse square of the distance; and that thus, in the

milky way, the telescope has shewn only $\frac{1}{25}$ part of the stars which it ought to have shewn. And he shews that the whole will be explained if we suppose that, in passing through a distance equal to that of an average star of the 1st magnitude, the loss of light is 1 per cent. From this he draws several remarkable conclusions. The reach of the 40-foot telescope is reduced from 2300 to 369. Taking the law of density of the stars (as depending on their distance from the galactic equator), as found in a former section, and combining this law of the extinction of light, he computes the brightness of the sky. He finds that, even in the centre of the milky way, supposed infinitely extended, the light of the stars beyond the reach of the 20-foot telescopes is only 12 per cent of the whole, but the light of those invisible to the naked eye is 92 per cent of the whole; that the whole light in the direction of the galactic pole is only 22 per cent of that in the middle of the milky way; that the ground of white light inseparable into stars by the naked eye, at the galactic pole, has only $\frac{1}{6}$ of the brightness of the milky way.

M. Struve concludes his work with an abstract of results obtained by Mr. Peters for the parallax of various stars. The general conclusion may be epitomised thus:—that the parallax of an average star of the 2d magnitude is $\frac{1}{10}$ of a second, and that of a star of the 1st magnitude little more than $\frac{1}{5}$ of a second. This result is then combined with others obtained by Argelander and Otto Struve, to obtain measures of the linear motion of the solar system. There are also some incidental discussions of the irregularity of proper motion, attributed by Bessel to *Sirius* and *Procyon.*

We have considered that the classical character, the ingenuity of the mathematical processes (in small details as well as in the more ostensible steps), and the importance of the results, of this remarkable treatise, deserved more than usual attention. The general character of the conclusions, we think, can scarcely be doubted, although their application must be subject to great irregularities. We conceive, for instance, that they exclude the possibility of such an annular arrangement of stars as has been depicted in some works intended to explain M. Mädler's views, detailed in the *Centralsonne.* If we might be permitted to comment on it in the way of criticism, we should remark, that the repeated assertion of the ascertained unfathomability of the heavens by the 40-foot telescope is scarcely supported by the expression of Sir W. Herschel, in the only place (we believe) where it is mentioned as probable; but the bearing of this assertion on the results of this treatise is not important.

Titles of Papers read before the Society between February 1847 and February 1848.

1847.

Mar. 13. Letter accompanying a Drawing of the Great Nebula of *Orion*, by Mr. Lassell.

Observations of *Neptune*, by Professor Challis and M. Rümker.

Corrected Elements of *Neptune*, by Mr. Adams.

Observations of *Astræa*, Cambridge, by Professor Challis; Hamburg, by M. Rümker.

Observations of Hind's Second Comet, by Messrs. Bishop and Hind; Berlin, by Professor Encke; Hamburg, by M. Rümker.

Occultations of Fixed Stars observed at Hamburg, by M. Rümker.

Sweeping Ephemeris for the Comet of 1556, by Mr. Boreham.

On some Discrepancies in Observing an Emersion of *Jupiter's* First Satellite, by Mr. Riddle.

On the Elimination of the Negative Sign in certain Astronomical Calculations, by Mr. Drach.

April 9. On an Important Error in Bouvard's Tables of *Saturn*, by Mr. Adams.

On the Developement of the Disturbing Function R., by Sir John Lubbock.

Ephemeris of *Astræa*, by M. d'Arrest.

Observations of the same: Hamburg, by M. Rümker.

Observations of *Neptune*: Cambridge (U.S.), by Professor W. C. Bond.

Observations of the Occultation of *Venus*: Hamburg, M. Rümker.

Observations of Hind's Second Comet in full Sunshine, by Mr. Hind.

Observations of Hind's Second Comet: Berlin, Professor Encke and Dr. Galle: Bonn, Professor Argelander and M. Schmidt; Hamburg, M. Rümker; Makerstoun, Sir T. M. Brisbane and Mr. Walsh.

Elements of Hind's Second Comet, by Mr. Hind, M. d'Arrest, and M. Schmidt.

On the expected Reappearance of the celebrated Comet of 1264 and 1556, by Mr. Hind.

On the Aurora Borealis of March 18, 1847, by Mr. Giles.

May 14. On the Discovery of a New Comet, by Professor Colla.

Observations of the same: Vienna, M. Littrow; Hamburg, M. Rümker; and by Mr. Hind and Mr. Dawes.

May 14. On the Identity of the Planet *Neptune* with a Star observed by M. Lalande, May 10, 1795, by Professor Schumacher.

Observations of *Neptune*: Cambridge, by Professor Challis.

New Elements of the same, by Mr. Adams.

Observations of *Astræa*: Cambridge, by Professor Challis; Hamburg, by M. Rümker.

Ephemeris of *Astræa*, by M. d'Arrest.

Observations of Hind's Second Comet: Cambridge (U.S.), Professor W. C. Bond.

Elements of the same, by Mr. Graham and Professor Bond.

On Wartmann's supposed Planet, by Mr. Hind.

Calcul detaillé d'une Inégalité nouvelle à longue période qui existe dans la Longitude moyenne de la Lune, by M. Hansen.

June 11. On the Discovery of a New Planet by M. Hencke, by Professor Schumacher.

Observations on the same: Berlin, Professor Encke; Hamburg, M. Rümker; Cambridge, Professor Challis; Liverpool, Mr. Lassell.

On the Orbit of Hencke's New Planet, by Mr. Hind.

Ephemeris of the same, by Mr. Hind.

Observations of *Neptune*: Cambridge, Professor Challis; Hamburg, M. Rümker.

Ephemeris of the same, by Mr. Adams.

Observations of *Astræa*: Hamburg, by M. Rümker.

Elements of the Binary Star *γ Virginis*, by Mr. Hind.

Ephemeris of the same, by Mr. Hind.

Observations of Hind's Second Comet: Berlin, by Professor Encke.

Elements of the same, by Mr. W. W. Boreham.

Observations of Colla's Comet: Vienna, by Professor Littrow; Padua, by Professor Santini; Hamburg, by M. Rümker; South Villa, by Messrs. Bishop and Hind.

Elements and Ephemeris of the same, by Mr. Hind.

Elements of the same, by M. d'Arrest and M. Quirling.

Sweeping Ephemeris for the expected Comet of 1264 and 1556.

On the Opinion of Copernicus with respect to the Light of the Planets, by Professor De Morgan.

Letter from Mr. Maclear, dated from the Kamiesberg, Cape of Good Hope.

On an Improvement in Tables of Proportional Logarithms, by Mr. Drach.

On the Formation and Application of Fine Metallic Wires in Optical Instruments, by Mr. Ulrich.

June 11. On the Proportions of Rock as a Foundation of the Piers of Meridian Instruments, with an Account of the Detection of a hitherto-unsuspected Cause of Error in the Edinburgh Transit, by Professor C. P. Smyth.

On the Discovery of a Satellite of *Neptune*, by Mr. Lassell.

Nov. 12. On the Discovery of *Iris*, by Mr. Hind.

Observations of the same: Cambridge, by Professor Challis; Göttingen, by Professor Gauss; Altona, by Dr. Petersen; Hamburg, by M. Rümker; Berlin, by Professor Encke.

Elements of the same, by Professor Challis, Mr. Graham, Professor Encke, Mr. Hind, and M. d'Arrest.

Observations of *Hebe:* Berlin, by Professor Encke; Altona, by Dr. Petersen; Hamburg, by M. Rümker; Cambridge, by Professor Challis.

Elements of the same, by Mr. Graham.

Observations of *Neptune:* Hamburg, by M. Rümker; Göttingen, by Professor Gauss; Cambridge, by Professor Challis; Cambridge (U.S.), by Professor Bond.

Observations of *Neptune* and his Satellite, by Mr. Lassell.

Ephemeris of the same, by Mr. Adams.

Observations of *Astræa:* Cambridge, by Professor Challis.

On the Discovery of Mauvais' Third Comet, by Professor Schumacher.

Observations of the same: Berlin, Professor Encke; Hamburg, M. Rümker.

On the Discovery of Brorsen's Third Comet, by Professor Schumacher.

Observations of the same: Altona, by Dr. Petersen; Hamburg, by M. Rümker; Berlin, by Dr. Galle.

Elliptical Elements of the same, by M. d'Arrest.

On the Discovery of a Comet, by M. Schweitzer.

Observations of the same: Altona, by Dr. Petersen; Hamburg, by M. Rümker.

Elements of the same, by Mr. Hind and MM. Quirling and Niebour.

Ephemeris of the same, by Mr. Hind.

On the Discovery of *Flora*, by Mr. Hind.

Observations of the same: Cambridge, by Professor Challis; Markree, by E. J. Cooper, Esq. and Mr. Graham; Berlin, by Professor Encke; Altona, by Professor Schumacher and M. Petersen; Hamburg, by M. Rümker.

Nov. 12. Observations of *Iris*: Markree, by E. J. Cooper, Esq. and Mr. Graham; Hamburg, by M. Rümker and M. G. Rümker.

Ephemeris of the same, by M. d'Arrest.

Observations of *Neptune*: Durham, by Professor Chevallier and Mr. R. A. Thompson; Hamburg, by M. Rümker; Poona, by Captain Jacob.

Observations of Lassell's Satellite of the same, by Mr. Lassell; Cambridge (U.S.), by Professor W. C. Bond.

On the Discovery of a Comet, by Miss Maria Mitchell.

Observations of the same: Cranbrook, by Rev. W. R. Dawes; Vienna, by MM. Littrow and Schaub; Cambridge (U.S.), by Professor W. C. Bond.

Elements of the same, by M. d'Arrest and Mr. G. P. Bond.

Observations of Mauvais' Third Comet: Havershill, by Mr. W. W. Boreham.

Observations of Colla's Comet: Vienna, by MM. Littrow and Hornstein.

Elements and Ephemeris of the same, by M. Littrow.

Observations of Schweitzer's Comet: Hamburg, by M. Rümker.

Elements of the same, by Mr. Pogson.

On the Annular Eclipse of October 9, 1847, by the Astronomer Royal.

On the Solar Spots, by Mr. J. H. Griesbach.

On the Eclipse of the Sun, April 15, 1847, by Capt. P. P. King, R.N.

On the Proper Motion of ε *Indi*, by M. d'Arrest.

Dec. 10. Observations of *Flora*: South Villa, by Messrs. Bishop and Hind; Cambridge, by Professor Challis.

Elements of the same, by Mr. Hind and M. d'Arrest.

Ephemeris of the same, by Mr. Hind.

Observations of *Hebe*: Cambridge, by Professor Challis; Makerstoun, by Sir T. M. Brisbane.

Observations of *Iris*: Cambridge, by Professor Challis; Makerstoun, by Sir T. M. Brisbane.

Ephemeris of the same, by Mr. Hind.

Observations of *Neptune*: Cambridge, by Professor Challis; Makerstoun, by Sir T. M. Brisbane.

Ephemeris of the same, by Mr. Adams.

Observations of Miss Mitchell's Comet: Cambridge, by Professor Challis.

Elements of the same, by M. Rümker and Mr. Pogson.

Ephemeris of the same, by Mr. G. Rümker.

Observations of Colla's Comet: Cambridge, by Professor Challis; Liverpool, by Mr. Lassell.

Observations of the Annular Eclipse of October 8, 9, 1847, at Bombay, by Captain Jacob.

Dec. 10. On the Appearance of Beads in Annular Eclipses, by Rev. Professor Baden Powell.

Results deduced from the Occultations of Stars and Planets by the Moon, observed at Cambridge Observatory from 1830 to 1835, by the Astronomer Royal.

On a Remarkable Star in the Great Nebula of *Orion*, by the Rev. W. R. Dawes.

Inscription on a Monument to Sir Isaac Newton, by the Rev. Charles Turnor.

1848.

Jan. 14. On the Perturbations of *Neptune*, by Mr. Pearce.

On an Appearance in the Moon, by Mr. Hodgson.

Observations of *Hebe*, by Lieut. Maury.

Observations of Colla's Comet and of the Satellites of *Uranus* and *Saturn*, by Mr. Lassell.

Elements and Ephemeris of Miss Mitchell's Comet, and various Observations, by M. Rümker.

Stars in the Path of *Flora*, by M. Rümker.

Elements of *Iris*, by Mr. Graham.

On the Longitude of Port Essington, &c. by Mr. H. Breen, jun.

Method of Calculating the Orbit of a Comet or Planet from Three Observed Places, by Professor Challis.

On the Erection of the Bombay Observatory Transit Instrument, by Captain Shortrede.

On the Perturbations of Planets and Comets, by Sir John Lubbock.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

Her Majesty's Government.
Royal Society of London.
Royal Society of Edinburgh.
Royal Irish Academy.
Hon. East India Company.
Hon. Board of Ordnance.
Royal Geographical Society.
Geological Society.
Royal Asiatic Society.
Zoological Society.
Linnean Society.
The Radcliffe Trustees.
The Registrar-General.

Manchester Literary and Philosophical Society.
L'Académie Royale des Sciences de l'Institut de France.
Royal Academy of Munich.
Royal Academy of Berlin.
The Editor of the Athenæum Journal.
L'Administration Impériale des Mines de Russie.
Italian Society.
Bureau des Longitudes.
American Philosophical Society.
British Association.
Royal Academy of Brussels.
Observatory of Vienna.
Observatory of Milan.
Observatory of George Town College, U.S.
Academy of Sciences at Naples.
Secretary of the American Survey.

G. B. Airy, Esq.
C. Babbage, Esq.
M. J. B. Biot.
M. Ed. Biot.
Dr. Von Boguslawski.
Professor Challis.
Professor Chevallier.
Professor Colla.
J. D. Dana, Esq.
Professor De Morgan.
S. M. Drach, Esq.
Rev. J. Edmonston.
Professor Encke.
T. M. Forster, Esq.
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Peter Gray, Esq.
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Professor Hansen.
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Thomas Kerigan, Esq.
Dr. Knorre.
Dr. J. Lamont.
W. Lassell, Esq.
Dr. Lee.
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Professor Mosotti.
Algernon, Duke of Northumberland.
Professor Quetelet.
J. Reeves, Esq.
Sir John Ross.
Professor Santini.
Professor Schumacher.
Com. Shadwell, R.N.
Rev. R. Sheepshanks.
Professor C. P. Smyth.
R. Snow, Esq.
Lieut. Stratford, R.N.
M. F. G. W. Struve.
R. Taylor, Esq.
B. L. Vulliamy, Esq.
H. Warburton, Esq.
Mr. J. Williams.

The President (*Sir John F. W. Herschel, Bart.*) *then addressed the Meeting on the subject of the award of the Testimonials as follows:*—

Gentlemen,—Whoever has watched the progress of science, whatever the department to which his attention has been turned, will not fail to have been struck with the fact that, however rapid its general advance, there occur, nevertheless, particular epochs in which the forward movement is more emphatically swift—epochs in which a sort of rush onward seems to be made, as if by some secret sympathy in men's minds urging them all at once, and with unusual energy, to exertion and discovery. In the science which it is the design of this Society especially to promote, one of these epochs of exuberant fertility seems to have manifested itself during the two last years; and I think it may be safely affirmed, that no period of equal duration in the history of Astronomy has furnished so many eminent and striking discoveries, or so many works, embodying the results of great masses of well-directed labour, destined to facilitate in so remarkable a manner the researches of future Astronomers, and to serve as data for their future investigations. Such, indeed, has been the productiveness of the epoch of which I am speaking, as to have obliged your Council to depart from the usual mode of procedure in awarding a medal to the single and most important astronomical work before them at the expiration of the year. This, indeed, could not have been done without throwing comparatively into the background so much distinguished merit as to be not only invidious but positively unjust. It is under these circumstances that the course has been adopted, after much and mature deliberation, which you have just heard explained by our Secretary, and which you have sanctioned at a Special General Meeting called for that purpose.

The first award on our list under this new system—(and here I should mention that the order of these awards is purely accidental, and that no priority or precedence is intended to be expressed in the antecedence of one name to another in the list)—the name which occurs first in the list before me is that of M. HANSEN, the Director of the Observatory of Seeberg in Gotha, already so advantageously known to us for his profound researches on the planetary perturbations, in which he has succeeded in presenting that intricate subject under an aspect altogether new, and one of great and peculiar power. It is not, however, for these general researches that this award is made, but for a more special investigation, viz. that of two new inequalities of very long period in the moon's motion; the one of 273 and the other of 239 years, the coefficients of which are respectively $27''\cdot4$ and $23''\cdot2$. These are considerable quantities in comparison with some of the inequalities already re-

cognized in the moon's motion, and, when applied, they are found to account for the chief—indeed the only remaining—empirical portions of the moon's motion in longitude of any consequence; so that their discovery may be considered as a practical completion of the lunar theory, at least for the present astronomical age, and as establishing the entire dominion of the Newtonian theory and its analytical applications over that refractory satellite.

The luminous exposition of the mode of mechanical action, by which these inequalities arise, with which the Astronomer Royal favoured us on the 14th of May last, must, I am sure, be too vividly impressed on the recollection of all who heard them, and of whom I perceive many here present, to need any recapitulation on my part. Suffice it to say, they both originate in the action of our nearest neighbour in the planetary system, *Venus*. The one in her direct influence in modifying the moon's gravity towards the earth by a periodical perturbative force, depending on 18 times the mean motion of *Venus*, *minus* 16 times that of the earth, which goes through its period in a time so little differing from one complete anomalistic revolution of the moon, as to produce a compound period (which is that of the action in question) amounting to nearly 4000 lunations, or 270 years. The other originates in an indirect action, of that nature which is sometimes conventionally called a reflected action, and of which the secular acceleration of the moon has afforded hitherto the chief and most remarkable instance. This, as I need hardly explain to such an assembly, originates in an oscillation of the excentricity of the earth's orbit due to the action of all the planets, *Venus* among the rest, by whose effect that orbit changes its *form* in a period of enormous length. The lunar inequality now in question originates in a periodical increase and diminution in the magnitude of the earth's orbit due to the action of *Venus* alone, the period being identical with, and the inequality in the earth's motion to which it corresponds, being the very same with that whose detection and exact calculation has done so much honour to the sagacity and mathematical skill of the Astronomer Royal himself, and whose discovery may be said to have completed the theory of the earth's motion, as it has furnished M. Hansen with the means of completing that of the moon.

The method by which M. Hansen has succeeded in calculating this last inequality is not yet published; but it is understood to be one of a very general, though of course a very laborious, nature, which includes, under one view, *all* the terms which go to make up concurrently an inequality of a given period. In his calculation of the former the usual methods are followed out, but terms of the third order of the excentricities and inclinations are taken account of; and it is in one of these that the chief part of this inequality originates,—a circumstance which may serve to give some idea of the depth beneath the surface from which it has been thus dragged to light.

The next name upon our list is that of Professor **Hencke**, of

Driessen,—a name rendered illustrious in a way of which Astronomy had previously furnished only a single instance, viz. by the discovery of two planets, *Astræa* and *Hebe*,—discoveries for which we now present him with one of our Testimonials. I am not aware of any peculiarity in the *method* of M. Hencke's search for these planets; but the search itself is a striking example of that determined and almost desperate perseverance which deserves success, even should it not always command it, but which, when brought to bear upon any department of natural knowledge, very seldom indeed goes unrewarded, though not always in the way originally contemplated. During a period of nearly fifteen years, M. Hencke had devoted himself to this especial branch of astronomical inquiry, comparing successive portions of the heavens *seriatim* both with his own delineations and registers of their contents and with the Berlin Maps, one of which (that of Knorre) was observed by him on the 8th of December, 1845, to be deficient in a star remarkably situated between two others of less magnitude marked on the map. This, and his own previous knowledge of the ground, at once assured him that, at length, his toils had met their reward. Had he desisted at this point, and content with this success, and weighing it with the labour it had cost him, decided that another fifteen years of life ought not to be hazarded on so precarious a venture, assuredly neither surprise nor blame would have attached to such a decision. But he reasoned otherwise. Aware of the vantage ground of practice and familiarity on which he stood, beyond what he occupied at first entering on his task,—perhaps, too, in some degree enamoured of the work itself, which not unseldom happens, and which is one of those beautiful intellectual adaptations which make useful labour in some considerable degree its own reward,—he persisted in the search; and on the 12th of July, 1847, the planet *Hebe* for the first time presented itself to his sight. And he still persists; and another, and yet another, member of our system, we will hope will own him for their discoverer. In a letter I had lately the gratification to receive from him, he informs me that he has completed charts of the third and tenth hours on the plan of the Berlin Star-maps, but on a scale *nine times as large*, admitting, in consequence, of an immensely greater detail in the entry of minute stars. Such work, carried out over the whole heavens, may perhaps be accomplished now the spirit is fairly roused by the accumulated efforts of astronomers, and will be, indeed, a precious bequest of this age to succeeding ones.

It is for an achievement precisely similar that one of our Testimonials has also been awarded to Mr. Hind, who, availing himself of the excellent instrument placed at his disposal by Mr. Bishop, and carrying out in their full extent the enlightened views of that gentleman in so placing them, has signalized himself by the discovery of two more of this singular group of planets, *Iris* and *Flora*, in quick succession, both having fallen to his fire within the surprisingly short period of two months of one another, viz. *Iris* on

the 13th of August, and *Flora* on the 18th of October, of last year. These discoveries were, of course, not the result of accident. Like those of Professor Hencke, they arose out of a systematic search, instituted expressly with this view, and commenced in November 1846, in which the Berlin Maps were employed so far as they extend, small stars 9·10 and 10 mag. not marked in them being inserted from time to time as they came under examination. The circumstances of the discovery of *Flora* were remarkable. Owing partly to the excellent mounting and optical power of the instrument employed, and partly to his own dexterity and precision in its use, Mr. Hind was enabled to satisfy himself, within little more than three hours from his first noticing it, that a star supernumerary in the 5th hour of the Berlin Maps had sensibly changed its place, and consequently felt himself authorized to announce it formally, as assuredly a planet, on the very night of its discovery.

The wish which I have uttered in the case of M. Hencke, I will repeat as respects Mr. Hind; may another, and yet another, planet reward his continued prosecution of this interesting line of research! He merits it by many titles. No name comes oftener before the astronomical world, as an assiduous observer and able computist in that department of astronomy which the nature of the instrumental means committed to his charge gives him an immediate connexion with—as a diligent observer of double stars and computer of their orbits, for instance—or as the first detector of several comets, one of them a very remarkable one, which, from his calculation of its orbit, he was enabled to follow up to its actual perihelion, and to behold it at noon-day presenting a clear and well-defined disc within 2° of the sun. Mr. Hind has also made himself advantageously known to us as having recently announced the probable return of one of the greatest comets recorded in history, that of 1264 and 1556, which he has apparently sufficiently identified as one and the same comet, and which, if his computations be correct, is probably at this very moment near upon its perihelion. I am more strongly induced to mention this, in order to give additional publicity and impressiveness to the conjuncture, that the few and now precious glimpses of the sky which seem to be destined for us in this most unastronomical of all possible winters may not be neglected. The situation of the orbit is most unfavourable for our observation. Happily for science, we have in our great southern observatory an astronomer who, now that he is enabled by the completion of his other arduous duties to devote his whole attention to the proper objects of the establishment, will not allow that or any other important astronomical phenomenon to escape him. I shall conclude what I have to say respecting Mr. Hind, by congratulating this Society on having for its Foreign Secretary one so well calculated to represent us worthily in our relations with our foreign associates and correspondents.

In connexion with the discoveries last alluded to, the name of Mr. Bishop has necessarily been mentioned; and here, therefore, I

shall take a liberty with the strict order in which the names occur in the list as they stand upon our Council-book (which order, as I have already observed, is purely accidental and indicative of no precedence), to call your attention to the merits of our worthy Treasurer in erecting that observatory, in furnishing it with the excellent and costly instruments with which those discoveries were made, and in providing so effectually as he has done for their due astronomical use. Other private observatories, no doubt, exist, furnished with admirable instruments, and from which much good and useful astronomical work has emanated and is emanating; but it does not fall to the lot of every private observatory to have added two planets to our list. Great and pre-eminent success, *as such*, in practical matters, is an element which cannot and ought not to be overlooked in public estimation, if only for example's sake. It may happen once, as a matter of good fortune; and it then only proves that laudable effort has not been marred by intrinsic causes of failure: but, when repeated, it becomes a test, and affords a final and practical assurance that the main conditions on which success hinges have been complied with; and it is such compliance which constitutes practical merit, which is the greater the higher in the intellectual and moral scale the object aimed at and accomplished. Now that Mr. Bishop has been eminently successful in the attainment of the object, and that object a worthy and a noble one, for which he has erected his observatory, cannot be disputed; and if we look to the elements of that success (laying aside his own personal share in the observations, which he has never on any occasion brought forward as interfering with the claims to the credit of discovery of those to whom he has confided the charge of his instruments), we shall find it not so much, perhaps, in the surpassing excellence of the instrumental means (though really excellent), as in the choice of his objects and the judicious selection of his observers. In this he has been more than fortunate—he has been wise; and that wisdom will become more generally apparent whenever the mass of invaluable observations of double stars accumulated by Mr. Hind's predecessor, my excellent neighbour and friend Mr. Dawes, shall see the light. I call them invaluable, because, independent of their having been made by probably the best observer in this particular line which Europe affords, they extend over an interval (from 1840 to 1844) during which the subject was not in course of being very strenuously pursued in any other quarter, and because the calculations which have been gone into respecting the orbits of double stars generally have shewn most remarkably the paramount importance of an *unbroken* record of their positions towards affording any certain conclusion as to their elements; and I have therefore no hesitation in saying that the publication of these observations, as well as of those since accumulated, whenever it shall take place, will give a fresh impulse to the theoretical part of this important and interesting branch of astronomy, at the very point where it is most needed. Independent of these observations, it will not be uninteresting to my hearers to

learn that observations on the whole of no less than fifteen comets, available for the determination of elements, have emanated from this observatory since the autumn of 1844, including three therein first or at least independently discovered; and that a mass of observations of solar spots, measures of the satellites of *Saturn*, diameters of the planets, places of nebulæ, variable and missing stars, and other points of interest, have been collected. The principal instrument is an eleven-foot equatoreal, with a seven-inch object-glass, by Dollond, mounted with remarkable solidity in 1837, and driven by a clockwork motion, as now so generally practised, to the singular facilitation and vast increase of accuracy of all observations. In the fitting up of this and of every other part, and especially in the means of determining the time by a transit and excellent clock, neither care nor expense has been spared. I think Mr. Bishop must feel an honest pride, whenever he enters that observatory, in reflecting that while devoting a portion of his ample means to the gratification of a dignified and intellectual taste, he has, at the same time, benefited science and augmented the glory of his country.

The next subject to which I must call your attention is that of Sir John Lubbock's researches on the Planetary theory, and especially those more recent portions of that inquiry which he has explained to us orally at our last meeting, and which form the subject of the fifth part of his work on the Lunar and Planetary Perturbations, where he has suggested, and to a certain considerable extent carried out, an altogether novel mode of procedure, and one specially intended to meet the more difficult cases where, all the usual facilities failing us, we are left to grapple with the problem of three bodies in all its unmitigated roughness. It is hardly necessary for me to say how valuable any suggestion—were it even only such a one as offered a *primâ facie* probability of success—must deserve to be considered which professes to meet such an exigency.

I should not do justice, however, to Sir John Lubbock's merits as a cultivator of this most difficult and intricate branch of geometry (and as it is, I can only hope to do so in the most meagre and imperfect manner), were I not to endeavour at least to give some slight account of his earlier researches: they are contained in a series of nine or ten profound and elaborate memoirs on the Theory of the Moon and Planets, which adorn the pages of the *Transactions of the Royal Society*, from the year 1830 to 1835 inclusive (for with respect to his papers on the Tides, they do not properly come within the scope of such a review)—memoirs which indicate a grasp of their subject such as, undoubtedly, no other of our countrymen had manifested up to the commencement of the period in question, and which would suffice to place him in an eminent position even among the most successful of its foreign cultivators. In fact, his object in commencing this series seems to have been to examine the subject to the bottom, to go into it

systematically, to reduce its combinations to rule and method, to verify the results already arrived at in respect of the Perturbative Coefficients, and to extend them. In the very first of them, however, we find the suggestions of an artifice or simplification which forms a feature in his latest speculations, viz. the assumption of the excentric in place of the mean anomaly of the perturbed planet for an independent variable, to which I shall have occasion presently to refer again. In this first memoir, too, he extends the theory of the stability of the planetary system demonstrated by Laplace, on the supposition of the neglect of the squares of the disturbing force, and on that of small excentricities and inclinations, so as to shew from the expressions of the variations of the elliptic constants that, however far the approximation is carried, neither the major axis, the excentricity, nor the tangent of the inclination, can contain any non-periodical term, and that their values, therefore, all oscillate within definite limits about a mean state. In this memoir he also gives the complete expression of the disturbing function to quantities of the second order, in seventy-four arguments, the coefficients of which he was enabled very soon after to exhibit much more simply, by reason of the relations subsisting among the Laplacian coefficients which they involve. This mode of expression, in another paper communicated to the Royal Society in the same year, he applied also to the theory of the earth's rotation on its axis, with the same results as to the stability of its dynamical equilibrium.

Extending his views to the Lunar theory, Sir John Lubbock was led very naturally, and I cannot help saying, as I think, happily and satisfactorily, as regards the common sense of the matter, to reunite the lunar with the planetary theory, from which it had been, to a certain extent, disjoined, by a totally different mode of treatment, adopted, in the first instance, by Clairaut, who had been followed in this by all subsequent writers on the subject down to Damoiseau, in which the true longitude of the moon, instead of its mean longitude, or the time, is adopted as the independent variable. This mode of procedure, while it affords undoubted facilities for developing the disturbing function, yet renders the solution of the differential equations far more complicated, and, finally, necessitates a gigantic process in the reversion of series for obtaining the longitude in terms of the time.

Weighing these advantages and disadvantages against each other, Sir J. Lubbock was induced to regard the latter as preponderant, and to adopt what may be called a planetary view of the lunar theory, using in it the same independent variable, and, of course, the same formulæ of developement, of the perturbative function. It may not be irrelevant here to remark, that in calculations of such enormous complexity, it does appear no slight collateral advantage that they should march as far as possible *pari passu*, since there is then less to verify, and far greater facility for the detection of error, than when the whole order of the process is from the beginning fundamentally different. Sir J. Lubbock has

effected the laborious developements necessary for these researches by means of tables for the combinations of the arguments, which form a very prominent feature in them, and which, by rendering it possible readily to construct and examine each particular term, go far to ensure the exactness of the whole work.

Steadily following up the same course of research, he next proceeded to extend the developements already given as far as the second to the third order of the excentricities, and in a remarkable paper (*Philosophical Transactions*, 1832, p. 601), he gives a method by which the coefficients of the inequalities of any order of excentricities are expressed, by theorems of great simplicity, in terms of those of inferior orders. The same method is also extended to the inclinations.

The last memoir in this series carries out the mode of developement which it had been the object of his former memoirs to explain, to the obtaining the analytical expression of those terms of the fourth order which enter into the secular inequalities, and, as an example of the application of this method, applies it to the equation of long period in the motion of *Venus* disturbed by the earth, bringing out a result perfectly coincident with that arrived at by the Astronomer Royal.

It would lead me too far—indeed, I do not presume sufficiently on my own attainments in this difficult branch of analysis (which are of a very low order indeed)—to enter into any comparison of the researches of Sir John Lubbock with those of other geometers; still greater presumption would it be in me to deliver an independent opinion as to their general power in overcoming the peculiar difficulties of the perturbative problem. Suffice it that your Council has regarded them as of prominent interest and value, and as holding a distinguished place in the archives of this great subject. If such merit can in any degree be estimated by the amount of work gone through, his researches may challenge comparison with those of almost any other adventurer in the same field. In fact, the intense and prolonged effort necessary to carry out such processes to their conclusion must command, not merely our respect, but our admiration.

I fear I shall hardly succeed in conveying to you a full and correct impression of that view of the perturbative problem which Sir J. Lubbock has more recently taken, as applicable to the extreme cases of the problem. It consists of two distinct portions, the general principle of one of which, at least, admits of an easily intelligible statement. It consists in the substitution, from the very beginning of the process of developement, of the numerical in place of the literal values of the elements of the disturbed and disturbing bodies—in treating each case, that is, in all its specialty, as if there were no other in the world. By so doing, all that enormous and exuberant detail of purely symbolic coefficients, involving the excentricities, inclinations, ratio of mean motions, &c., shrinks up at once into specific numerical statement, a mere number in each particular coefficient standing in the stead of the whole

algebraic combinations, however complicated; these numbers being derivatives one from another, it is true, by definite rules, but those rules being adhered to, the numbers of which they are derivatives stand aside, and continually give place to the resultant ones.

The other feature in the proposed method consists in a peculiar mode of ensuring, in the extreme cases contemplated, the convergency of the series expressive of the well-known perturbative radical by which the Laplacian coefficients are introduced in the ordinary planetary theory; by separating it into two factors; and by facilitating the reduction of those factors by means of numerical tables, of which Sir J. Lubbock has caused specimens to be computed, and which apply to such violent cases as the perturbation of *Pallas*, and the several periodic comets by *Jupiter* and *Saturn*. In these researches, moreover, he rejects the time as an independent variable, at least in the case of an inferior disturbed by a superior planet, adopting in its place neither the mean nor the true longitude of the disturbed planet, but a quantity as it were intermediate between them, or holding a sort of middle position in respect of mutual derivability, viz. the excentric anomaly: thus following up, after a long interval, the suggestion thrown out for simplification in his earliest paper on the planetary theory.

Beyond what I have said, I should despair of giving any idea of so abstruse and difficult a theory without using symbolic expressions; nor indeed on this latter part of the subject do I apprehend that Sir John Lubbock's own views are fully matured.* Let us hope that he will accept of the testimony we offer him, not only of high expectations raised in us by the views which he has laid before us, and of interest in his struggles throughout so formidable a conflict, but of our grateful recognition of what he has already done, and of the honourable position which he has held for so long a period as the champion of British geometry applied to the full and complete developement of the planetary and lunar theories.

The subject of the planetary perturbations introduces naturally and appropriately the two names next on our list, those of M. Le Verrier and Mr. Adams—names which, as Genius and Destiny have joined them, I shall by no means put asunder; nor will they ever be pronounced apart so long as language shall celebrate the triumphs of Science in her sublimest walks. On the great discovery of *Neptune*, which may be said to have surpassed, by intelligible and legitimate means, the wildest pretensions of *clairvoyance*, it would now be quite superfluous for me to dilate. That glorious event and the steps which led to it, and the various lights in which it has been placed, are already familiar to every one having the least tincture of science. As all praise on my part of the powers, skill, and perseverance which led to this great discovery would be superfluous, so it would be more than superfluous—it would be presumptuous—in me

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* Sir J. Lubbock gave an account of his method at the ordinary meeting in January. An abstract, received too late for insertion in the *Notice* for that month, is subjoined to this Address.

to enter into any comparison of the methods employed by those eminent individuals for the resolution of their arduous problem. That a truth so remarkable should have been arrived at by methods so different by two geometers, each proceeding in utter ignorance of what the other was doing, is the clearest and most triumphant proof which could have entered into the imagination of man to conceive, of the complete manner in which the Newtonian law of gravitation stands represented in the formulæ of those great mathematicians who have furnished the means by which alone this inquiry could have been entered on; and how perfect a picture—what a daguerrotype—those formulæ exhibit of its effects down to the least minutiæ! Meanwhile, we await with interest the explanation which further observation and calculation will furnish of the striking fact of the actual mean distance of the new planet falling so far short of that which was originally contemplated, and which, though proved erroneous, yet led to so close an approximation to its true place. I will only add, that as there is not, nor henceforth ever can be, the slightest rivalry on the subject between these two illustrious men—as they have met as brothers, and as such will, I trust, ever regard each other—we have made, we could make, no distinction between them on this occasion. May they both long adorn and augment our science, and add to their own fame, already so high and so pure, by fresh achievements!

I have next to direct your attention to the Zone observations of Professor ARGELANDER, of Bonn, recently published as the first volume of the Astronomical Observations of the observatory attached, by the liberality of his Majesty the King of Prussia, to the University of that city, for which the Council have decreed the award of a similar Testimonial. The intention of his Majesty to establish there an observatory of the first class was declared in 1836, but various delays in respect of the choice of a site and the erection of a suitable building intervening, on the completion of the transit instrument, M. Argelander, the director of the establishment, procured its erection in a small temporary observatory, not apparently very well situated, but sufficiently so for the attainment of every necessary precision in differential observations, and resolved to devote it to the completion of a review and catalogue of stars from the 45th to the 80th degree of north declination. The lower limit was determined, of course, by the cessation at that declination of Bessel's Zones. As regards the latter, M. Argelander appears to have considered that provision enough had been made for the stars within 10° of the pole by the catalogue of Groombridge, by the excellent observations of Professor Schwerd, and by a numerous series of observations of his own at the Observatory of Helsingfors.

In order to adapt the transit instrument (a 5-foot one, with a 4-inch object-glass by Ertel, carrying a magnifying power of 108 as its ordinary working power) to this object, it was fitted (besides the usual small circle of 6 inches' radius for setting the instrument)

with a brass sector 18 inches' radius, duly counterbalanced and divided on silver from 5′ to 5′, read off by a microscope magnifying 20 times, and carrying a micrometer for subdivision. The observations were carried on by Professor Argelander himself at the instrument, observing the right ascensions chiefly on one wire, seldom on two, and rarely on more; while his assistant, M. Kysæus, read off the declinations, until obliged by ill health to desist, when his place was supplied by M. Henkel. The usual duration of a sitting was about two hours, seldom more, the work becoming too fatiguing for all parties. The breadths of the zones went on increasing from 2° between the declinations 45° to 51°, to 3° from 51° to 66°, 4° thence to 74°, after which a single zone of 6° completed the work up to 80°.

Absolute determinations of declination were not attempted; all the observations, therefore, are necessarily referred to zero stars occurring in each zone. For these M. Argelander states himself indebted to the catalogues of Pond, Airy, and Groombridge, availing himself, however, of Professor Johnson's reobservations of the Groombridge stars at the Radcliffe Observatory, which he considers as exceedingly accurate. Rümker's catalogue was also consulted, as well as M. Argelander's own catalogue of 560 stars for 1830. All these catalogues were first compared *inter se* for all the zero stars employed, and a set of curves projected expressive of their differences; the results of which preliminary examination are tabulated, and the catalogues so reduced to a common term by the application to the stars in each of its appropriate small correction.

The right ascensions are so far absolute, as that the position of the instrument (which was found too unsteady to allow of dependence on it for any long interval), besides the usual fundamental stars, was especially referred to twelve well-determined stars from 80° to 87° of declination. The clock correction was ascertained by the observation of the usual fundamental stars, and others perfectly well determined, observed immediately before or after the zone. The preface contains a careful and full exposition of the investigation of all the instrumental corrections which can affect the accuracy of the determinations, as well as of the mode of reduction followed to bring the apparent positions to the beginning of the year 1842, which is selected for the epoch, and of the probable errors to which the determinations, both in right ascension and declination, can be considered liable; the former of which appear to be exceedingly minute, and the latter is stated as amounting to 1″·0305.

The total number of observations recorded in these zones (204 in number) is 26424, of which about 4000 are duplicates, making 22000 stars observed. They are registered in nine columns, containing respectively,—1. The number for reference; 2. The observed magnitude; 3. The thread transited; 4. The time of transit; 5. The reduction to the middle thread; 6 and 7. The microscope reading and the sum of its corrections; 8. The observed declination. The last column upon every page, besides the clock corrections for

several epochs in the duration of the zone, and the error of declination and special remarks, contains tables upon the plan of Bessel's for the immediate reduction of any star in the zone to the common epoch, so that nothing is wanting but the application of the numbers given by these tables, the arrangement of the whole in order of right ascension, and the taking of means of duplicate observations, to convert the volume into a complete catalogue.

The necessity of such catalogues, extending over the whole surface of the heavens, is becoming yearly more and more manifest. Independent of their value as affording points of exact reference for comets and the smaller planets, it cannot be too strongly insisted on, that among the infinite multitude of the smaller stars we know not what discoveries may turn up, nor to what extent among them "Luciferous instances" (*instantiæ luciferæ*) of proper motion, variability, or other physical peculiarities, may come to be noticed. M. Argelander, therefore, we think, merits in a high degree the gratitude of astronomers for his discernment in fixing upon a task so well adapted to the actual means at his disposal, and the perseverance and skill with which he has executed it; and from this specimen, as well as from his admirable star-maps and their accompanying catalogue of magnitudes, and from the efficiency with which he has filled at Abo and at Helsingfors a similar office to that he now holds at Bonn, we augur every thing from his exertions when that observatory shall be completed according to the munificent intentions of his royal patron.

The reduction of the Greenwich observations of the moon from 1750 to 1830, next claims our attention; a work undertaken at the expense of the British Government, at the recommendation and under the superintendence of the Astronomer Royal, over and above, and out of the line, of his ordinary astronomical duties as such. These cannot without manifest injustice be considered to extend beyond the full and effectual working of the establishment during his own connexion with it, and the complete presentation of its products to the public, in the best and most available form for immediate and future scientific use, which the actual state of astronomical science at the time of publication can devise and furnish data and means to perform. To travel back into the past —to reduce the observations of his predecessors by the application of data which they did not possess, and of principles and methods unknown in their days—to give these observations a unity, of which at the time of their production they were incapable, and to present them in a shape available to a state of science which their makers could hardly have imagined possible;—such a performance, however gracefully and appropriately it may come from the hands of an Astronomer Royal, can hardly be considered as any part of his duties. The task which Bessel performed towards the observations of Bradley, though in effect amounting to a revivification of his labours, could by no means be regarded as a duty neglected by a Maskelyne or a Pond, however honourable it might have been to

either to have performed it, neglecting no other. The astronomical world has, however, already seen with gratitude and admiration this useful, and as it has been on one occasion very appropriately called, pious, work executed by him in a most masterly manner, as respects the planetary observations made in the Greenwich Observatory. That work will remain to the latest posterity a monument of national glory, to which the world has not produced, and probably never will produce, any thing comparable, unless it be this its forthcoming companion. The filling up of the great outline struck by Newton, with the analytical expression of the laws of lunar and planetary motion, we owe to other nations, and especially to the French. We grudge them not this glory. They have fairly won it, and it is theirs. But the broad basis of observation, upon which this magnificent superstructure has been reared, is British—essentially, thoroughly, and *nationally* British. In that observatory it was created. Such has been the mission of that establishment, and such the present Astronomer Royal has judged (and well and wisely judged, as I conceive) it must continue to be—to furnish now, and in all future time, in an unbroken series, the best and most perfect data by which the laws of the lunar and planetary movements, as developed by theory, can be compared with observation.

The great work to which I now call your attention is not yet actually published, but it is in all essential points entirely ready for publication, and waiting only for the printing of supplementary tables for the Introduction. It will be for the lunar observations, *mutatis mutandis*, all that the work I have before mentioned is for the planetary; and indeed a great deal more, as the following account of its contents (which I have been furnished with by the Astronomer Royal himself) will shew.

"The first section of the tabular part exhibits the elements of reductions in right ascension, comprehending in the same section the observations of the clock stars, and the observations of the moon, and their reductions as far as the inferred right ascension of the moon's centre.

"The second section contains the elements of reductions in north polar distance. This section, from the changes in the character of the instruments employed, and from the changes in the mode of using the same instrument, is necessarily divided into a great number of different forms. It comprehends the observations of the moon, and of stars when required, and their reductions as far as the inferred north polar distance of the moon's centre.

"The third section contains the longitude and ecliptic north polar distance, deduced from the right ascensions and north polar distances of the preceding sections; and also the longitude and ecliptic north polar distances, deduced from Plana's theory (modified in a very few points); and the comparison of these two systems of results. It contains, besides, the value of the elliptic inequality, the annual equation, the parallactic inequality, the variation, the evection, the inclination, and the evection in ecliptic north polar

distance; and also the effects of changes in the arguments of the greater part of these inequalities for every observation of the moon. These numbers, as well as the numbers expressing the differences between the observed and the tabular places, are all rendered positive by the addition of proper constants. In this shape the observations present facilities for grouping, such as probably have never before been given in collections of a similar kind; and they are at once available either for the correction (both in coefficient and in epoch) of the principal equations whose titles are stated above, or for the determination of the coefficient of any other equation which any theorist may consider yet doubtful.

"The fourth section contains a comparison of the observed right ascensions which are unaccompanied by polar distances, with the right ascensions computed from the theory.

"The fifth section contains the sums for every year of groups of the numbers given in the third section. These groups are formed in reference to the magnitudes of the various quantities related to the inequalities included in the columns of the third section; thus there are sums of groups corresponding to large and to small values of elliptic inequality—to large and to small values of change of elliptic inequality for a change in its epoch, and so on, In this form the results of the reductions are applied with great ease to the correction of elements.

"The Introduction contains full explanation, not only of the modes of calculation, elements, and tables, employed in every part of the work, but also of the researches into the methods (unexplained by the observers) of making some of the observations, and into the value of the moon's semidiameter given by the telescopes used at different times."

It will hardly be necessary for me to add, that neither of these works could have been planned, the processes and formulæ of reduction fixed upon, and the work laid out so as to assume that ultimate form in which the theorist will find precisely what he wants to know for the improvement of the tables, unless by one thoroughly and profoundly familiar with the theories they are destined to elucidate, and a complete master of the history of every detail. A vast computing force (no less than fourteen, under the immediately responsible superintendence of Mr. Breen) has, of course, been laid on, and for the liberality with which the cost of so great an operation has been supplied by our Government, the public ought to feel gratefully sensible. Anyhow, however, the labour of its superintendence must have been enormous. Nor have they been even already without their fruits. The exhibition to Professor Hansen, in the summer of 1846, of the course of the corrections of the epoch of the lunar motion, fluctuating as they were found to do in a manner inexplicable by the usually received equations, is considered by the Astronomer Royal to have given occasion to those investigations, on the part of that eminent geometer, which terminated in the two remarkable discoveries I have already spoken of, and of which we have this day endeavoured to

shew our sense by a Testimonial. A similar Testimonial I now hand over to Mr. Airy for this great work—a work which renders uniformly available to the theorist no less than 8000 observed places of the moon, compared with theory by the computation of the same number of places. each separately and independently calculated from Plana's *Formulæ ;* points which I mention as most effectually tending to convey to the mind of any one who has ever calculated a place of the moon *ab initio*, some adequate idea of the immensity of the undertaking.

I have next to call the attention of the Meeting to a very important and remarkable work,—Colonel Everest's *Account of the Measurement of Two Sections of the Great Meridional Arc of India.* "When the Indian Government, about the beginning of the present century, was about to undertake a topographical survey of their territory, they resolved to establish it upon accurate trigonometrical operations, and, fortunately for the interests of astronomy, as well as the success of their special undertaking, the superintendence of the survey was committed to the late Lieut.-Colonel Lambton. This indefatigable and meritorious officer, at different times, and as circumstances permitted, measured a series of continuous meridional arcs, extending from Punnæ, near Cape Comorin (lat. 8° 9′ 35″), up the middle of the peninsula to Damargida (lat. 18° 3′ 15″), or nearly 10°, and was engaged upon another section to the north of the last-mentioned station, when he fell a sacrifice to his unremitting personal exertions in 1823. His successor, Colonel Everest, continued the operation then in progress, and extended the triangulation northwards from Damargida, first to a place called Takalkhera (where Colonel Lambton had intended to place the limit of the section), and, subsequently, to Kalianpur (lat. 24° 7′ 11″), at both of which stations sector observations were taken for determining the celestial amplitudes. Of the details connected with the measurement of these two sections, forming together an arc of rather more than 6°, he gave a full account in a work published in 1830. In the execution of these operations, a series of hardships, privation, and suffering (arising from the unhealthy nature of the country through which the triangulation was carried, and exposure during the rainy season), were encountered, to which no similar operation presents any parallel. Partly from these causes, and partly from the defective state of the principal instruments, the results were not considered as possessing that degree of certainty and precision which is necessary at the present day. In 1825, Colonel Everest returned to England for the recovery of his health, which had suffered severely. During a residence of five years in Europe, he made himself acquainted with all the improvements which had then been introduced into practical geodesy: and in 1830 he returned to India, furnished, through the liberality of the East India Company, with magnificent instruments and apparatus of all kinds requisite for the prolongation of the Great Arc, which it was now determined should be extended

through the whole of the British territory to the Himalaya Mountains. The arc which has been actually measured consists of two sections, each complete in itself. The northern section extends from the old station at Kalianpur to Kaliana (lat. 29° 30′ 48″), and the triangulation was even carried about 70 miles to the north of this station—in fact, to the lower range of the Himalayas; but it was considered that the celestial observations, if made beyond Kaliana, would be liable to disturbance from the attraction of that stupendous mountain chain. The other section extends from Kalianpur southwards to Damargida, and is the same arc which was formerly measured, but which has now been entirely remeasured with instruments of the first class and methods altogether unexceptionable. The amplitude of the northern section is 5° 23′ 37″; of the southern, 6° 3′ 56″; so that the whole addition to the Indian arc, depending on the labours of Colonel Everest, is 11° 27′ 33″. Three bases, each between seven and eight miles in length, were measured by compensation-bars, according to General Colby's method, with extreme care, and, as the verifications shew, with extreme accuracy. Theodolites, with 3-foot azimuth circles, were used for taking the geodetic and azimuthal angles; and astronomical circles, on the same magnificent scale, for the celestial amplitudes. No labour or expense was spared to attain the utmost precision. The measurement of the bases, and the comparisons of the measuring and standard bars, were made under tents. In parts of the country where there were no natural elevations, towers of solid masonry were built up to a height averaging 50 feet at the principal stations, and the instruments and signals were accurately placed over carefully defined centres. The observations were repeated, and the angles taken so as to eliminate instrumental errors, and obtain every possible verification. The azimuths were observed at fourteen different stations along the arc, the altitudes of the stations determined by reciprocal observations with 18-inch circles, and the amplitudes by simultaneous observations of the zenith distances of stars at the extremities of both sections. The ordinary difficulties inseparable from an extensive operation of this nature were aggravated in the present case by various causes. The instruments were new and untried, and, when brought into the field, were found to require extensive alterations. In a European country the instrument-maker is at hand; at the foot of the Himalayas the geodesist must rely on his own resources.

"Of the manner in which Col. Everest contrived to remedy the defects of the Astronomical Circles, an account has already appeared in our *Memoirs*. His ingenuity and perseverance met with deserved success, for the whole of the observations appear to have been made in an extremely satisfactory manner. The merit of the actual performance of a work attended by so much difficulty is greatly enhanced by the manner in which the results are placed before us. The comparisons of the measuring bars and standards, the readings of the theodolites and circles, the corrections applied, the computations and final results, are all set forth in well-arranged tables, so

that the astronomer is put in possession of every element necessary for verifying the results, or deducing other results by different methods of calculation. Viewed by itself, the measurement of an arc of 11°½ of the meridian is an operation of great interest to astronomy; but Col. Everest's work derives great additional interest from its connexion with that of Col. Lambton. From the conjoined labours of the two illustrious geodesists we have now a continuous meridional arc, extending from Punnæ to Kaliana—upwards of 21° in length—by far the longest line which has yet been measured on the earth. Nor is its interest limited even by this view. Its extension a few hundred miles further to the north (by no means an impossible undertaking) would bring it into connexion with the Russian triangulation; and thus we may look forward to an unbroken chain of triangles extending from Cape Comorin to Nova Zembla. The two individuals, Col. Lambton and Col. Everest, who began and completed this important measurement, have earned for themselves a distinguished place among the benefactors of science; and in awarding to them the praise which is due to their talent, their zeal, and their devotion, the historian of astronomy will not omit to remark the obligations which his science owes to the East India Company, by whom the means were provided of carrying the tedious and costly operation into execution. The Great Meridional Arc of India is a trophy of which any nation, or any government, of the world have reason to be proud, and will be one of the most enduring monuments of their power and enlightened regard for the progress of human knowledge."

So far our worthy Vice-president, Mr. Galloway, who has been kind enough to draw up for me this brief but impressive account of the Indian arc, which I have been prevented from doing myself, however much I could have desired to do so, by the very great pressure caused by the number of important subjects claiming attention on this occasion, and by the immense extent of the work itself. I can only add, that I entirely concur in the view taken of it; that I heartily congratulate both Colonel Everest and the East India Company on its completion, and that I trust the former will find in his native country a complete restoration of that health which his labours, under circumstances of such dreadful exposure, had so seriously undermined.

It remains for me to notice another more valuable work, and indeed an indispensable one in all active observatories, for which one of our Testimonials has been awarded to its author, Professor MAXIMILIAN WEISSE, entitled, *Catalogus Stellarum ex Zonis Regiomontanis*. It will be remembered that the Gold Medal of the Society was given, in 1829, to the illustrious Bessel, for his observations of stars in zones between 15° of south and 45° of north declination. The first portion of this great undertaking, viz. from 15° north to 15° south, was accomplished in the years 1821–1825, the remainder in the years 1825–1833; and the observations, with tables of reduction, are appended to the Königsberg observations

for those years, in the Numbers from 7 to 17. The zone observations of Bessel were after some time partially incorporated in the star-maps of the Berlin Academy, to which we already are indebted for the discovery of, and for the earliest revelation of, the visible existence of a fifth new planet, and to which no doubt astronomy will have to record many more obligations of a similar nature. But the star-maps of the Berlin Academy, and their accompanying catalogues, do not profess to give more than approximate places for 1800, and are thus only useful for identifications and approximations, &c. They do not afford the means of fixing with accuracy the place of a planet or comet differentially compared with them.

Soon after the completion of the first portion of Bessel's Zones, their reduction into a catalogue was undertaken by Professor Weisse, Director of the Observatory of Cracow, with the advice and aid of the great observer himself; it appears that the catalogue was completed ten years ago, and forwarded to M. Struve, who had undertaken to edit and publish the work for the Petersburg Academy of Sciences. The delay is explained by the pressure of astronomical business, which for some time fully occupied the observers of Poulkova.

This catalogue contains all the stars observed by Bessel within 15° of the equinoctial, arranged and numbered like Piazzi's in hours of right ascension. It is printed in double columns in a large quarto form. The magnitudes, right ascensions to hundredths of seconds of time, and the declinations to tenths of seconds of space, are given for each star to the epoch 1825; and besides the annual precession for each element, the secular variation of precession is also given. The necessity for saving room has induced the author to omit the sign for the precession and of its secular variation. But the rules for the first are simple and familiar to all astronomers, and a short table is given to point out the sign of the secular variation.

The preface by M. Struve is in Latin, and contains a full account of the formulæ used by Professor Weisse, and an examination of the probable errors of the catalogue itself. Of the utility of such a catalogue, containing 31,895 stars in this portion of the heavens, there is no need to say a word, nor of the superior convenience of arranged catalogues over observations in zones scattered through many volumes, not to be procured easily or cheaply. But it is, besides, highly probable that, generally speaking, the reduction will be more correct than the original entries, as there is no examination so critical as a careful reduction. Moreover, all the errors and hesitations are avoided which an amateur observer, at least, would probably commit while performing the reductions himself. At the same time it is right to state, that errors must of necessity exist in so extensive a work—errors both of observation and of reduction—errors which nothing short of a comparison of the printed work with the actual state of the heavens can entirely do away with. The work, as observed, has been edited by, and its publication provided for, at the recommendation of M. Struve, who has thus added another to the many and great obligations which astronomical science owes to him.

On the Perturbations of Planets and Comets. By Sir J. W. Lubbock, Bart.

The methods which form the basis of our tables of the older planets may be considered perfectly sufficient for that purpose, the sensible errors of those tables being due to the imperfect numerical developement of the theory, and not to any defect of the theory itself. These methods, however, suppose the orbits to be nearly circular and little inclined to each other, and are therefore inapplicable to the case of the periodical comets, and to that of several of the small planets. The only memoir, so far as the author is aware, which professes to gives a general solution of this problem, is due to M. Hansen, and is translated in the *Conn. des Temps* for 1847. In this memoir, M. Hansen has more particularly considered the case where the disturbed body is inferior, and has illustrated his method by the numerical calculation of the perturbations of Encke's comet by *Saturn*. The disturbing function is expressed in terms of sines and cosines of multiples of the excentric anomaly of the disturbed planet, and of the true anomaly of the disturbing planet. Advantage is then taken of the small excentricity of the orbit of the latter body, to convert the sines and cosines of multiples of the *true* anomaly into sines and cosines of multiples of the *mean* anomaly. The process, however, is very laborious, even in the case which M. Hansen has considered, and becomes far more so when *Jupiter* is the disturbing body. As the functions which require to be integrated are exhibited in terms of two variables, M. Hansen is obliged to integrate *by parts*, so that each term gives rise to a complicated series of other terms.

The method proposed by the author differs widely from that of M. Hansen. The numerical values of the elliptic constants are inserted at the earliest possible stage, no *literal* developement being attempted. When the disturbed body is inferior, the co-ordinates of the disturbing body may be expressed in terms of the excentric anomaly of the disturbed body, and thus the latter becomes the only variable involved in the resulting expressions, and the required integrations may be directly performed.

When the planet disturbed is superior to the disturbing planet, the only method which the author can suggest is to develope in terms of the true anomaly of the disturbed planet and the mean anomaly of the disturbing planet, and to integrate *by parts*.

Although a certain facility is afforded by the method of developement formerly proposed by the author (see *Monthly Notice*, vol. vii. No. 14), yet as the operations remaining are very complicated and liable to error, and as the disturbing function itself is never the *only* one whose developement is required, he now thinks it preferable to determine the coefficients of the developement by means of a sufficient number of particular values of the function to be developed. By this method any function, however complicated, may

be developed as a whole; and the operations required, though long, are very simple.

The author has endeavoured to facilitate, as much as possible, the determination of the perturbations by the use of *Tables.* This can only be done in the case of a numerical developement.

In the present paper, the author considers only the case in which the orbit of the disturbed body is within that of the disturbing body.

The rectangular co-ordinates of any heavenly body may be very simply expressed in terms of its excentric anomaly. Tables have been calculated by Mr. Farley, and are given, containing the values of the constants which enter into these formulæ for the planets and periodical comets whose orbits are known.

Hence it is easy to obtain particular values of the co-ordinates and other quantities which are required in calculating the disturbing forces for given values of the excentric anomaly. Tables are given containing the values of these quantities for *Jupiter* and *Saturn*, corresponding to every fifth degree of excentric anomaly. These will be useful in every case of perturbations produced by those planets.

The disturbing force is usually decomposed into one of these two rectangular systems, viz. either a system of forces parallel to the axes of co-ordinates, or one in which two of the forces are in the plane of the orbit of the disturbed body, and respectively parallel and perpendicular to the radius vector, and the third is perpendicular to the plane of the orbit. The forces of the former system are given immediately in terms of the co-ordinates of the bodies, and those of the second system may be easily derived from them.

The well-known formulæ which give the differential coefficients of the elliptic elements with respect to the time are transformed into others, in which the excentric anomaly of the disturbed body is the independent variable. In these expressions the disturbing forces are multiplied by certain functions of the excentric anomaly, the values of which, corresponding to both of the above-mentioned systems, are given, and may be tabulated for given values of the excentric anomaly.

Hence may be found any number of particular values of the differential coefficients of the elliptic elements corresponding to given values of the excentric anomalies; and it only remains to obtain from these particular values the general developement of these quantities in such a form as to admit of being easily integrated.

The following is the method which the author employs for this purpose: — If ξ ξ' denote the mean anomalies, v v' the excentric anomalies, and n n' the mean motions, we may put

$$\xi' = \frac{n'}{n}\,\xi + \alpha, \quad \alpha \text{ being a constant}$$

$$= \frac{n'}{n}\,v + \alpha - \frac{n'}{n}\,e \sin v.$$

Hence, if $\frac{n'}{n}v+\alpha$ be called $\mathfrak{n}$, the mean anomaly of the disturbing planet will never differ widely from $\mathfrak{n}$, since $\frac{n'}{n}$ is a fraction.

The author shews how to obtain the developement of the differential coefficients in terms of sines and cosines of multiples of v and $\mathfrak{n}$; and then, since $\mathfrak{n}=\frac{n'}{n}v+\alpha$, the required integrations may be immediately performed.

In conclusion, the author points out the relative advantages of the method of mechanical quadratures, and of those in which the values of the elliptic elements or the co-ordinates are expressed in series.

The Meeting then proceeded to the election of the Council for the ensuing year, when the following Fellows were elected, viz.:

President:

Sir John F. W. Herschel, Bart. K.H. M.A. F.R.S.

Vice-Presidents:

J. C. Adams, Esq. M.A.
Thomas Galloway, Esq. M.A. F.R.S.
John Lee, Esq. LL.D. F.R.S.
Captain W. H. Smyth, R.N. K.S.F. D.C.L. F.R.S.

Treasurer:

George Bishop, Esq.

Secretaries:

Augustus De Morgan, Esq.
Captain R. H. Manners, R.N.

Foreign Secretary:

John Russell Hind, Esq.

Council:

G. B. Airy, Esq. M.A. F.R.S. Ast. Roy.
George Dollond, Esq. F.R.S.
Rev. George Fisher, M.A. F.R.S.
Rev. Robert Main, M.A.
William Peters, Esq.
Rev. Baden Powell, M.A. F.R.S.
Lieut. Henry Raper, R.N.
Edward Riddle, Esq.
William Rutherford, Esq.
Rev. Richard Sheepshanks, M.A. F.R.S.

SPECIAL GENERAL MEETING.

Pursuant to a Resolution of the Council, a Special General Meeting was holden after the business of the Annual Meeting was concluded, agreeably to the bye-laws (Sect. IV. § 9), to take into consideration the propriety of expelling from the Society certain Fellows, whose names had been duly suspended in the meeting-room as being in arrear of their annual contributions, unless the arrears due by them to the Society should have been paid up before that day.

Sir J. F. W. Herschel, Bart. President in the Chair.

The Secretary reported, that since the notice had been circulated two of the Fellows therein named had paid the amount of the arrears severally due by them to the Society at the time when the notice was issued.

The following motion was made and seconded, and carried unanimously:—

> That the Ballot be not proceeded with at present, and that it be referred to the Council to consider the expediency of taking steps to enforce, by legal means, the payment of the arrears due to the Society, in all or any of the cases.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *March* 10, 1848. No. 5.

Capt. W. H. Smyth, R.N., Vice-President, in the Chair.

Thos. C. Janson, Esq., F.L.S., Stamford Hill, Middlesex, was balloted for, and duly elected a Fellow of the Society.

FLORA.

Observations.

Makerstoun. Equatoreal. (Sir T. M. Brisbane & Mr. Brown.)

Date.	Makerstoun M.T.	R.A.	N.P.D.	Star of Comparison.	No. of Obs.	Hind's Ephemeris, — Obs. R.A.	Hind's Ephemeris, — Obs. N.P.D.
1847.	h m s	h m s	° ′ ″			s	″
Dec. 28	7 52 55	4 12 50·67	74 29 53·9	B.A.C. 1328	5	−0·64	−4·2
30	8 24 34	11 53·80	74 20 24·4	— 1366	9	0·66	6·3
	8 40 25	53·21	19·5	— 1380	6	0·35	4·5
1848. Jan. 5	10 23 47	10 0·35	73 49 37·7	— 1329	15	0·46	−1·7
7	8 40 13	9 42·55	39 16·9	— 1350	2	−0·29	+0·8
13	7 51 46	9 43·75		— 1356	10	+0·02	
	7 52 50		73 5 58·1	— 1356	6		−4·1
15	7 17 6	10 2·48	72 54 31·8	— 1346	4	−0·05	7·1
	7 41 28	2·67		— 1356	14	0·03	
	7 41 35		22·6	— 1356	8		3·9
18	7 20 44	10 47·83	36 43·4	— 1346	8	0·11	5·3
	8 6 31	48·41	31·9	— 1365	7	0·09	5·2
19	7 28 47		30 40·9	— 1365	5		4·7
	7 35 44	11 7·51		— 1365	9	0·09	
20	7 29 44	11 29·16		— 1365	10	0·12	
	7 45 5		24 34·6	— 1365	4		3·9
21	7 31 33	11 53·03	72 18 33·0	— 1365	5	−0·14	2·5
25	6 51 15	13 47·75	71 54 16·3	Rümker 1162	15	+0·25	4·5
26	7 22 39	14 22·52	47 57·7	— 1162	12	0·33	4·0
31	7 9 29	17 41·65	16 56·7	B.A.C. 1361	8	0·14	0·0
	7 34 58	42·28	52·1	— 1376	11	0·30	2·0
Feb. 2	7 52 21	4 19 15·70	71 4 20·9	— 1376	15	+(0·21)	−(3·2)

The observations are corrected for refraction and parallax.

The observations were made by Mr. John Welsh, with a spider's-line micrometer. The apparent place of the compared star has been computed from the catalogue referred to.

DURHAM. (Prof. Chevallier & Mr. R. A. Thompson.)

	G.M.T.	R.A.	N.P.D.	No. of Comp.	Star.	
1847.	h m s	h m s	° ′ ″			
Oct. 27	10 37 35	5 3 52·73		5	*a*	
28	10 39 26	3 42·37		5	*a*	
Nov. 1	10 1 44	2 33·54	76 9 19·4	2	B.Z. iv. 1312	
2	11 40 59	5 2 8·63	10 7·9	5	— —	
9	9 58 47	4 58 19·47	13 21·5	8	— —	N.P.D. doubtful.
16	11 16 15	52 41·13	13 15·3	4	B.A.C. 1500	
19	13 2 23	49 46·28	11 53·9		Meridian.	
	12 11 0	48·56	53·4	7	B.A.C. 1500	
Dec. 3	12 5 2	34 41·25		6	— —	
	12 34 3		75 53 31·3	2	— —	doubtful.
11	10 33 48	26 8·13	75 34 13·4	8	— 1409	
1848.						
Jan. 5	10 23 49	10 0·41	73 49 42·1	7	— 1329	
11	8 21 5	9 34·29	17 16·5	2	— 1350	
13	10 37 48	9 44·63		7	— 1356	
	10 37 48	44·62		7	— 1346	
	10 21 18		73 5 25·2	7	— 1356	
26	8 32 14	14 23·93		9	H.C. 8125	
	8 26 20		71 47 39·2	8	— —	
28	7 48 57	15 37·11	35 25·3	7	B.A.C. 1361	
	10 57 10	42·04	34 38·8	1	— —	
31	6 51 52	17 40·59	17 5·4	8	— —	
	9 26 14	45·53	16 26·8	1	— —	
	10 27 49	47·23	16 11·4	4	— —	
Feb. 1	9 57 16	5 18 31·64	71 10 10·0	10	ι Tauri	good.

The observations are chiefly made with the Fraunhofer equatorial: they are corrected for parallax, but not for refraction.

Assumed apparent places of stars compared,—

	Mag.		R.A.	N.P.D.
			h m s	° ′
a	9	Oct. 27	5 5 58·80	76 4 (approx^t.)
Bessel Zones iv. 1312	7		4 58 7·74	76 7 15″·0

Deduced from 2 comparisons with B.A.C. 1500. The mean places of the other stars are taken from the catalogues cited.

HAMBURG. Merid. Circle & Transit. (MM. C. & G. Rümker.)

	Hamburg M. T.	R.A. Mer. Circle.	R.A. Transit.	Declin.
1848.	h m s	° ′ ″	″	° ′ ″
Jan. 3	9 20 4·4	62 37 15·7	21·7	+15 59 26·0
4	15 53·3	33 27·0	31·5	16 4 35·8
5	11 44·7	30 16·2	17·2	9 48·3
6	7 38·0	27 35·0	...	15 9·6
7	9 3 34·1	25 33·7	34·3	20 29·3
8	8 59 32·8	24 12·9	11·3	25 50·9
12	43 50·1	24 27·9	...	16 48 10·8
16	8 28 44·0	62 33 52·6	57·0	+17 11 29·2

The transit observations are by M. G. Rümker.

Elliptic Elements by Dr. Brunnow, Director of the Observatory at Bilk, near Düsseldorf.

Epoch 1848, Jan. 0, Berlin Mean Time.

	° ′ ″
M	35 24 13·86
π	33 3 5·76
☊	110 15 2·33
i	5 53 34·24
φ	8 58 43·86
μ	1085·5122

Log *a* ...... 0·3429133 Sid. Revol. 1193·901 days.

An Ephemeris by Dr. Brunnow, for January, came too late for use.

IRIS.

Durham. (Prof. Chevallier & Mr. R. A. Thompson.)

1847.	G.M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Obs.	Star.
Nov. 16	6 48 57	20 44 46·18	102 29 59·6	3	B.A.C. 7296
17	7 43 50	46 27·54	24 50·7	2	— —
Dec. 8	6 8 22	21 23 19·31		3	B.A.C. 7435
8	6 26 31		100 10 25·4	2	— —

The observations are corrected for refraction, but not for parallax.

Extract of a Letter from Mr. Cooper.

"Mr. Graham, my first assistant at Markree Observatory, compared *Iris*, on the 24th of January last, with a star of 9·10 mag., not to be found in any catalogue we possess. The apparent place of the star on Jan. 23 was found to be

R.A. 22ʰ 57ᵐ 16ˢ·08 N.P.D. 92° 27′ 11″·1

by 5 micrometrical comparisons with a star in *Bessel's Zones* and in the *Hist. Cél.* As it seems to be variable, the star is worth attention, and its place may be of use to some planet-hunter."

URANUS.

Hamburg. Meridian Circle. (M. Rümker.)

1848.	Hamburg M.T. h m s	R.A. ° ′ ″	Dec. ° ′ ″
Jan. 4	6 0 3·3	13 27 54·4	+5 4 22·0
5	5 56 10·4	28 27·4	4 35·3
6	5 52 16·2	29 6·3	4 54·6
7	5 48 23·0	13 29 47·1	+5 5 15·0

NEPTUNE.

Durham. (Prof. Chevallier & Mr. R. A. Thompson.)

	G.M.T.	R.A.	Obs.-Cal.	N.P.D.	Obs.-Cal.	No. of Obs.	Star.
1847.	h m s	h m s	s	° ′ ″	″		
Nov. 17	9 23 6	22 0 3·45	−0·90	102 52 2·1	+1·1	5	B.A.C. 7747
19	9 18 34	0 6·11	0·69	51 46·7	0·1	2	— —
1848.							
Jan. 11	5 46 11	22 4 7·11	−0·58	102 29 39·9	+0·1	3	B.A.C. 7722

The observations are corrected for refraction and parallax, assuming the Hor. Equat. Par. = 0″·3. The calculated place is taken from Mr. Adams' ephemeris.

Hamburg. Equatoreal. (M. Rümker.)

	Hamburg M.T.	R.A.	Dec.
1848.	h m s	° ′ ″	° ′ ″
Jan. 9	6 15 35·4	330 58 9·8	−12 30 57·1
16	6 9 5·3	331 10 50·4	−12 26 22·4

Satellite of Neptune.

From a discussion of Mr. Lassell's Observations, and those made at Cambridge, U.S., Dr. Peirce finds the following elements of the Satellite.

	d h m
Time of Revolution	5 21 12·4
Long. Ascending Node	119°·8 supposing the motion direct.
Inclination	29 ·9
Time of Northern Elongation, 1847,	Nov. 26^d·53, Greenwich M.T.
Greatest Elongation............	16″·5

Dr. Peirce states the corresponding mass of Neptune to be $\frac{1}{18780}$ of the sun.

MAUVAIS' COMET.

Cambridge. Northumberland Equatoreal. (Prof. Challis.)

	Greenwich M. T.	R.A.	N.P.D.
1848.	h m s	h m s	° ′ ″
March 3	11 58 6·0	10 50 35·02	71 32 15·9
7	12 46 40·7	10 41 3·39	71 55 45·7

Not corrected for parallax.

March 3 Compared with Hist. Cél. 21083
7 —— 20827 = B.Z. 456, $10^h\ 39^m\ 28^s$

The place of the first star is taken from the Hist. Cél.; that of the second is a mean of the authorities cited (which agree very well), regard being had to the secular variations.

CAMBRIDGE, U.S. Large Equatoreal. (Professor Bond.)

1848.	Cambridge M.T. h m s	R.A. h m s	Dec. ° ′ ″	No. Compˢ.	Star comp.
Feb. 29	12 43 55	10 57 23·1	+18 42 48	11	*a*
March 1	15 22 0	10 54 37·8	+18 36 57	12	*a*
	16 37 0	30·2	46	2	*b*

	Mag.	App. R.A. h m s	App. Dec. ° ′ ″	
a	9	10 56 16·84	+18 43 11·5	in Bessel's Zones 456
b	7	10 58 40·53	+18 33 34·2	——

The observed differences of Right Ascension have been applied to the position of the star of comparison referred to the Mean Equinox of Jan. 1, 1848.

On Feb. 25th, at $12^{h}\ 23^{m}\ 30^{s}$, the Comet preceded a star 9 mag. by $4^{m}\ 21^{s}{\cdot}8$, and was south of it 1′ 8″ by 3 comparisons, using the declination circle of the equatoreal. Approximate place of star,

R.A. $11^{h}\ 11^{m}\ 54^{s}$ Dec. +19° 3′.

Mauvais' Comet was found without difficulty, from its place given by Dr. Peirce's Elements, when in the vicinity of the nebula *h* 843, which it resembled in size and brightness. It was bright enough to allow the use of red illumination and the wire micrometer. There were indications of the stellar point so frequently noticed at its first appearance, and from this, a faint, diffused, nebulous light extends for some distance."

Professor Bond thinks the above observations may be relied upon.

Sweeping Ephemeris for the expected Comet of 1264 *and* 1556.

From Mr. Hind's Tables in the *Notice* for April 1847, p. 264.

Per. Pass.	March 31.		April 10.		April 20.		April 30.	
	R.A.	N.P.D.	R.A.	N.P.D.	R.A.	N.P.D.	R.A.	N .P.D
1848.	h m	°	h m	°	h m	°	h m	°
May 20	9 16	74·1						
30	9 13	82·7	8 29	70·9				
June 9	9 9	86·1	8 43	78·5	8 17	70·2		
19	9 6	88·0	8 47	82·3	8 32	76·4	8 19	70·4
29	9 2	89·2	8 48	84·6	8 37	80·0	8 31	75·4
July 9			8 47	86·1	8 40	82·3	8 36	78·7
19					8 40	84·2	8 38	80·9
29							8 39	82·6

The first vertical column contains the hypothetical date of perihelion passage: the places of the comet corresponding to each hypothesis will be found in the same horizontal line with the perihelion passage, and below the date to which they belong. The R.A.'s are given to minutes, and the N.P.D.'s to tenths of degrees; but the object of the ephemeris is merely to point out the quarter of the heavens in which the comet is to be looked for, and the sweeps should extend pretty widely beyond the data of the ephemeris. If any one should be fortunate enough to catch the comet, it is requested that immediate notice may be given to the Foreign Secretary, Mr. HIND, No. 3 Allsop Terrace, Regent's Park. A similar ephemeris for the whole year, computed by Mr. George Bond, is inserted in the *American Almanac* for 1848, and was communicated to the Society several months ago.

MISS MITCHELL'S COMET.

Elements.

Miss Mitchell has computed the following Elements of the Comet discovered by her on Oct. 1, 1847.

Perihelion Passage, 1847, Nov. 14·499, Greenwich M.T.

	°	′	″
Longitude Perihelion	274	10	6
Node	189	35	29
Inclination	71	33	32

Per. Dist. = 0·341348. Motion Retrograde.

Account of the Annular Eclipse of 9th November, 1847.

By Major Lysaght.

Hingolee, at which station the following observations were made, is situated in Lat. 19° 43′ 12″; Long. 77° 7′ 5″ E. The former may be depended upon as correct, but the latter is open to correction.

The weather was very unpromising, and heavy clouds shewed themselves in the forenoon; but a short time previous to the commencement of the eclipse they cleared off towards the western horizon, and left the required part of the heavens beautifully clear and serene, with a light wind.

The observations were made with a Dollond's 3½-foot refractor: 2·7 inches' aperture and power 25, with a coloured glass, which gave the sun a greenish yellow colour. A thermometer was placed against a brick wall with the sun shining directly on its bulb, and a barometer and a spirit thermometer in the shade of an open verandah: the times were noted by an assistant with a chronometer, adjusted to mean time by an observation of the sun in the morning.

The day was exceedingly hot for the season of the year; the exposed thermometer standing at 129°·5 a short time before the commencement of the eclipse, but it fell *immediately after the time of first contact was given* to 92°·2.

Before the commencement of the eclipse the spots on the sun appeared fainter than usual, or than I had observed them a day or two before with a smaller telescope; but the faculæ were very bright. As the moon advanced over the sun, the spots became much darker and well defined, and round the largest (near the centre) was a dark, fine ring, conforming to the shape of the spot, the intervening space being of the same dull colour as the rest of the sun.

The eye having been withdrawn for a little time from the telescope, the *exact* time of first contact was lost by a few seconds.

On nearing the solar spots, the moon, which, up to this period,

was well defined, became undulating, and this undulation increased until the annulus was about to form, when the lower limb again became steady and well defined, and the upper, first much serrated, and then *hillocky.* At first this was attributed to the lunar mountains, but except in two or three places they all subsided. Immediately before the formation of the annulus, and on the western edge, a dark line was seen to connect the limbs of the sun and moon, and gave the idea of a post raised *gradually* from behind *on one* of the *hillocks*, and extending to the sun's limb. This was followed by another; both remained a few seconds, but the manner of their disappearance was not particularly observed; then appeared a thin thread of light, which was noted as the formation of the annulus.

As the ring increased in breadth, the southern limb of the moon became pinnacled, and an instantaneous blaze of light was seen, which had more the appearance of a fire suddenly breaking out on a windy night in dry grass on the summit of a jungly hill (as often seen in this country), than of exploded gunpowder, or any thing else I can liken it to.

The moon's limb again became smooth, leaving a hillock on the eastern side, which, as she advanced, *gradually* elongated, and became pointed, when another post was erected like the former two, but more slowly (so much so that I was nearly turning my eye in another direction, not expecting to see the phenomenon), and remained somewhat longer; this broke in the centre, and the two parts shrunk slowly into the limbs of the sun and moon.

The clouds, which had at the commencement settled down to the western horizon, had again risen, and now approached, and I gave up the hopes of seeing the breaking of the annulus, or end of the eclipse.

There was not much apparent diminution of light during the existence of the annulus, nor were any stars visible, but every thing had a light blue colour.

At $3^h\ 7^m$ P.M., gunpowder was ignited in about two minutes with a lens of 3 inches diameter; but at $3^h\ 23^m$ P.M. it could not be exploded, although the lens was held over it for seven minutes, and care was previously taken to dry the powder.

Before the commencement of the Eclipse.

Barometer	$28^{in}\cdot31$	
Thermometer attached	93°	
Ditto exterior	129·5	exposed to the sun.
Time of first contact	$1^h\ 38^m\ 25^s\pm$	
Formation of annulus	3 21 14	

At the middle of the eclipse.

Barometer	$28^{in}\cdot27$	
Thermometer attached	$89^{\circ}\cdot7$	
" exterior	92	exposed to the sun
Spirit thermometer	84	minimum temperature of air during the eclipse.

The barometer and thermometers are corrected by the standards of the Surveyor-General of India.

Remarkable Appearances during the total Eclipse of the Moon on March 19, 1848.

Extract of a Letter from Mr. Forster, Bruges.

"I wish to call your attention to the fact which I have clearly ascertained, that during the whole of the late lunar eclipse of March 19, the shaded surface presented a luminosity quite unusual, probably about three times the intensity of the mean illumination of an eclipsed lunar disc. The light was of a deep red colour. During the totality of the eclipse, the light and dark places on the face of the moon could be almost as well made out as in an ordinary, dull moonlight night, and the deep red colour, when the sky was clearest, was very remarkable from the contrasted whiteness of the stars. My observations were made with different telescopes, but all presented the same appearance, and the remarkable luminosity struck every one. The British consul of Ghent, *who did not know that there was an eclipse*, wrote to me for an explanation of the blood-red colour of the moon at 9 o'clock.

"The sky was of unusual brilliancy, as often occurs between showers; there was a bright aurora in the north, and a most magnificent meteor descended obliquely towards the north-west horizon about the time of the central eclipse. The western margin of the disc presented a rough, uneven appearance at this time. What would be the effect on the dark surface of the moon of extensive aurora borealis on our earth?"

Mr. Walkey, who observed the eclipse at Clyst-St. Lawrence, near Collumpton, says the appearances were as usual till 20 minutes to 9. "At that period, and for the space of the next hour, instead of an eclipse, or the umbra of the earth being the cause of the *total* obscurity of the moon, the whole phase of that body became very quickly and *most beautifully illuminated*, and assumed the appearance of the glowing heat of fire from the furnace, rather tinged with a deep red. The above description I gave to the editor of one of the Exeter papers, and some one has attempted to solve the peculiarity of the appearance by speaking of the umbra and penumbra, which might have been the cause of it. But such a solution has nothing to do with the appearance, the whole disk of the moon being as perfect *with light* as if there had been *no eclipse whatever.*

"Having spoken of this appearance, I was informed by one or two individuals that they had seen, between twenty minutes to nine and twenty minutes to ten, a very luminous appearance of the aurora borealis. Now, it strikes me that the light reflected from this northern effulgence might have caused the *luminous appearance* of the moon in this part of the country at the time when it was under the perfect umbra of the earth in other portions of England.

"Many more than threescore years have passed with myself,

and during that period I have several times beheld an eclipse of the moon, but never before did my eyes behold the moon positively giving *good* light from its disk during a total eclipse. The phases of the moon perfectly corresponded with the authorised diagram up to the period of 8^{h} 40^{m} and after 9^{h} 40^{m} to the end of the eclipse."

Occultations of Fixed Stars observed by Mr. Rümker, Hamburg.

	B.A.C.		Hamburg M.T. h m s	
1847.				
Feb. 25	2486	68 Gemin. *k*	10 27 55·3	Immersion
March 22	1692	115 Tauri	7 22 12·0	—
May 28	5112	35 Libræ ζ^4	10 2 38·8	—
June 22	4521	76 Virginis	8 57 54·6	—
Oct. 26	1526	Tauri	9 25 51·0	Emersion
1848.				
Jan. 26	1420	87 Tauri *α*	5 16 20·8	—
	By M. G. Rümker		21·5	—

(The nomenclature of the stars has been altered to make it agree with that of the British Association Catalogue.)

Occultations observed at Poona, by W. S. Jacob, Esq.

Lat. 18° 31′ 36″, N.; Approx. Long. 4^{h} 55^{m} 42^{s} E.

1847.
Dec. 13. Occultation of *θ Aquarii*, Poona Sidereal Time.

Immer. 1^{h} 38^{m} $11^{s}.5$ instantaneous; Emer. 2^{h} 45^{m} $37^{s}.0$ instantaneous.

Dec. 16. Occultation of *Saturn*, Poona Sideral Time.

Immer. 3^{h} 40^{m} $7^{s}.2$ *i.e.* total disappearance; Emer. 4^{h} 51^{m} $35^{s}.5$

The planet was not visible at emersion until it was about 2″ separated from the moon's limb, or about 4^{s} after true emersion: 4^{s} must, therefore, be substracted from the emersion stated. Planet very dim.

Extract of a Letter from Mr. Maclear.* (*Cape of Good Hope.*)

"I have observed all the stars which Professor Mädler wished me to observe except one which is now coming into visibility. The reductions are proceeding.

"I have got the 46-inch achromatic on the polar axis, and am proceeding with the adjustments. . . . . The dome may be turned with the little finger. There is a little too much side-play, for our violent winds keep it in constant oscillation; but this can easily be checked, and on the whole I am very well satisfied. The practical knowledge I have acquired will, I trust, be useful when the large equatoreal (which is daily expected) arrives. . . . .

"Observations have been commenced, or rather resumed, of the

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* See the last *Annual Report*, p. 87.

following list of stars for the detection of annual parallax. β *Hydri*, α *Phœnicis*, α *Eridani*, α *Columbæ*, η *Argûs*, δ, α^1 and α^2, γ and β *Crucis*, ι, β, α^1 and α^2 *Centauri*, α *Circini*, B. A. C. 5233, β, α *Trianguli*, α *Gruis*."

Observations of α Centauri and other Double Stars made at Poona. By W. S. Jacob, Esq., late Capt. Bengal Engineers.

These consist of several measures of α *Centauri* extending over nearly three years, during which time the angle of position has increased 8°, and the distance diminished 3″. There are observations of 6 other stars, some of which are deemed to be *probably* revolving. The author has appended elements of the orbit of α *Centauri*, a star which is known to have a very sensible parallax.

On the Annual Oscillations of the Level and Azimuthal Errors of the Greenwich and Cambridge Transit Instruments. By Mr. Henry, of the Royal Observatory, Greenwich.

On comparing the level errors of the Greenwich and Cambridge transits for every month through several years, Mr. Henry finds that there is in each instrument an annual variation of considerable regularity. The western pivot, in spring, is always higher relatively to the eastern pivot than at any other season, and lower in autumn. This maximum and minimum coincides pretty nearly with the months of March and September. As the Y adjustments of the Greenwich instrument have not been touched for eleven years (it is believed those of Cambridge have been almost as little disturbed), a tabular statement of the mean level errors for the months of March and September, during the last few years, will shew this variation very distinctly: each level error is the mean of four weekly observations: the sign + signifies that the west end is higher than the east, and — the contrary.

Transit Level Errors.

	GREENWICH.				CAMBRIDGE.		
Years.	March.	Sept.	Ann^{l}. Var^{n}.		March.	Sept.	Ann^{l}. Var^{n}.
	″	″	″		″	″	″
1836	+2·88	—0·28	3·16	1833	—0·86	—3·30	2·44
7	0·54	0·93	1·47	5	+2·11	1·96	4·07
8	2·32	0·18	2·50	7	—3·14	3·71	0·57
9	1·08	0·61	1·69	8	—3·23	—6·97	3·74
1840	1·64	0·49	2·13	9	+4·10	+1·78	2·32
1	2·21	0·54	2·75	1840	2·62	+1·68	0·94
2	3·03	—0·16	3·19	1	+0·49	—3·12	3·61
3	2·42	+0·93	1·49	1842	—3·18	—5·35	2·17
4	3·78	—0·16	3·94				——
1845	+2·76	—0·39	3·15				
			Mean 2·55				Mean 2·48

Thus it appears that both instruments give nearly the same value for the extent of the variation.

Mr. Henry suggests, as a query, whether this annual fluctuation can be attributed to some annual change in the spirit level. This is not likely: first, because we cannot well see how any change in the zero of this instrument should affect reversed results; and, secondly, because any change of scale, if arising from temperature, could scarcely be so consistent in its indications, and, moreover, could not well affect *mean* temperatures so sensibly while imperceptible at *extreme* temperatures. The cause is not obvious, nor is it quite certain, as yet, that the phenomenon is of universal occurrence.

There is a change of similar nature in the azimuthal errors of both instruments, as will be seen from the tabular statement below. The sign + means, that the telescope points to the east of south, or that the west pier and pivot are too much to the south.

Transit Azimuthal Errors.

	GREENWICH.				CAMBRIDGE.		
Years.	March.	Sept.	Annl. Varn.		March.	Sept.	Annl. Varn.
	″	″	″		″	″	″
1841	+3·22	+2·80	0·42	1836	+11·10	+7·30	3·80
2	4·63	2·53	2·10	1840	0·72	−0·70	1·42
3	5·02	2·55	2·47	1	4·77	+1·33	3·44
4	5·73	3·09	2·64	1842	+3·27	+3·09	0·18
1845	+2·92	+1·53	1·39				
			Mean 1·80				Mean 2·21

It seems pretty certain, from the foregoing tables, that the western Y, in both the Greenwich and Cambridge transits, is about 2″·5 higher at the vernal than at the autumnal equinox, and that it is also about 2″ more to the south at the first than at the second season.

On the Interior Satellites of Uranus. By the Rev. W. R. Dawes.

In the *Monthly Notices* for January last were printed some observations of an interior satellite of *Uranus*, which had been made in the autumn of last year by Mr. Lassell and M. Otto Struve. The results are, in several respects, interesting and remarkable. The fact, that one observer always saw the close satellite on the *northern* side of the planet only, while the other as uniformly observed it only on the southern side, is sufficiently curious to invite further investigation.

It is however obvious, that the observations at Starfield and at Poulkova are utterly incompatible with each other. While the latter point to an approximate period of $3^{d}\ 22^{h}\ 10^{m}$, the period indicated by the former is only about $2^{d}\ 2^{h}\ 43^{m}{\cdot}6$. The *distance*

also of the satellite carefully estimated by Mr. Lassell on Nov. 6, 1847, under favourable circumstances and with great probability of considerable accuracy, was only 11″; the position-angle being estimated 349°. Now, assuming the direction of the major axis of the projected orbit to be from 10° to 190°, as determined by M. O. Struve for the satellite observed by him; and assuming also, that the apparent ellipticity of the orbit does not greatly differ from that of the orbits of the bright satellites I. and II.; we find that the distance of the satellite, at its greatest elongation, would be 12″·2, on the supposition that the distance was correctly estimated at 11″ when the position-angle was 349°. But this is almost precisely the greatest elongation theoretically due to a satellite revolving about *Uranus* in the period indicated by Mr. Lassell's observations. We are thus led to the conclusion, that there are at least *two* satellites interior to the nearest bright one: and to avoid the confusion which might arise from applying numbers of any kind to the smaller satellites, I beg permission to denominate them for the present, *a*, *b*, *c*, &c., in the order of distance from the primary;—*a* being the satellite observed by Mr. Lassell, and *c* the satellite observed by M. O. Struve.

M. O. Struve suggests that the satellite observed by him may lose much of its light when in the northern portion of its orbit; and this may be the reason why Mr. Lassell did not see it on Nov. 6, 1847; on which favourable night *c* must have been near its greatest northern elongation. On all the other nights when *a* was observed by Mr. Lassell, *c* was very close to the planet, with one exception only, on Sept. 14; at which time *c* was near its greatest elongation southwards, and might perhaps have been seen if the night had been sufficiently good. Neither Mr. Lassell, however, nor myself then observing with him, perceived any such object in that place.

It should here be stated, that the estimated position for Sept. 14, as given in the printed table, appears to be erroneous. It is inconsistent with the diagrams independently made at the time by Mr. Lassell and myself, which, taking the *measured* position of II. as a guide, shew that the position of *a* was about 80° north *preceding*;—whereas the angle as printed is 80° north *following*. It seems clear, therefore, that the angle should be 350° instead of 10°. This being rectified, and the position-angles computed for the times of observation, by reckoning back from the peculiarly valuable observation of Nov. 6 as an epoch, and assuming a period of $2^{d}\ 2^{h}\ 43^{m}\cdot 6$, the estimated angle *minus* the calculated angle comes out, for Sept. 14 = −2°; for Sept. 27 = −2°; for Sept. 29 = +1°; for Oct. 1 = +2°.

That the satellite *a* should never have been seen by M. O. Struve may arise from its becoming faint in the southern portion of its orbit, as *c* probably does in the *northern*. It appears, from calculation on the assumptions before mentioned, that on every night when M. O. Struve saw *c*, with the only exception of Dec. 10, *a* was in the southern portion of its orbit; yet sufficiently distant

from his observed position of *c* to render any confusion between them impossible. On Nov. 28, indeed, the position-angles of the two satellites must have been almost precisely the same: but the measured distance of *c* was 16″·85; while the distance of *a* could not have exceeded 11″ in that part of its orbit. It should be noticed, with reference to the non-observation at Poulkova of the satellite *a* on Dec. 10, that though on that night near its greatest northern elongation, it was at a smaller distance from the primary than *c* ever was when it was observed. Unless, therefore, the night were unusually fine, so faint an object might easily be overlooked.

So long ago as the autumn of 1845, Mr. Lassell occasionally saw a faint object, supposed to be a satellite, at about the same distance from the planet as *a* was observed to have been last year; and, with only one exception, it was always seen on the *northern* side of the primary, and usually in the north *preceding* quadrant, in which it was uniformly seen in 1847. On Oct. 5, 1845, at $12^h\ 26^m$ Greenwich mean time, being on a visit at Starfield, I had the gratification of seeing this satellite in the 20-foot reflector. When the light of the planet was hidden from the eye by a bar, the satellite became steadily visible; and a careful diagram being made, both by Mr. Lassell and myself independently, the position-angles deduced from them agreed within 3°, the mean being 324°·1. This is very nearly the same with the estimated position on Sept. 27, 1847; and assuming, that in the interval of 721·8896 days, 342 complete revolutions had been performed, the period comes out $2^d\ 2^h\ 39^m\ 36^s$. It seems probable, therefore, that the period of this satellite does not differ much from that quantity.

Supposing that those nights on which the satellites I. and II. were measured at Starfield, in 1847, were probably favourable, though *a* was not noticed, it becomes interesting to know whether *a* were then at such a distance from the planet as might allow it to be visible in the 20-foot reflector. I have, therefore, computed the places of *a* for each of those nights; and the results shew, that only on Oct. 16 was it in the northern portion of its orbit, and not very close to its primary. On every other occasion, therefore, it was probably either invisible in the southern portion of its orbit, or overpowered by its vicinity to the planet.

By a similar computation, it becomes evident, that on none of those nights was the satellite *c* near its greatest southern elongation; and that, therefore, it was probably invisible on the northern side of the planet, or too near it to be discerned.

It is singular, that in the whole series of observations at Starfield and Poulkova, only one night, Nov. 1, is common to them both; and that was of so indifferent a quality at Starfield as to render it improbable that so difficult an object as the satellite *c* could have been detected: *a* was then in the south following quadrant, and rather near the planet, so that it was not seen at either place of observation.

On the whole, therefore, it seems highly probable, that the interior

satellites observed by Mr. Lassell and M. O. Struve are entirely distinct; that the one becomes invisible in the southern part of its orbit, and the other in the northern; and that, during the last apparition of *Uranus*, it has so happened, that each satellite has been seen only by its own observer. If either of them is the same as was discovered by Sir W. Herschel, it seems most likely to be that observed at Poulkova.

The object observed at Starfield on Nov. 6, 1847, and supposed to be an intermediate satellite between I. and II., was estimated to be only 10″ distant from the planet. But its position was then almost precisely *opposite* to that of I., whose distance was estimated at 20″. It is, therefore, obvious, that if this were a satellite, its orbit must be *interior* to that of I. It could not, however, have been *c*, which must at that time have been near its greatest *northern* elongation, and therefore probably invisible. Moreover, its greatest distance could be only about 15″¼; and it would, therefore, be nearly intermediate between *a* and *c;* and for the present it may be distinguished as *b*. Though it may seem premature to attempt any conclusions from a single observation of so difficult an object, yet, on the other hand, the observation of Nov. 6 was peculiarly worthy of reliance. The night was unusually fine. The planet was viewed for two hours, during which time the supposed satellites were carried along with it. The distance also of *b* was estimated just half that of I., which was almost exactly opposite to it. And that the estimated distance of I. (20″) was nearly correct, appears from comparing it with the *measured* distance of the same satellite (20″·57) on Oct. 11, when it was in almost precisely the same part of its orbit. If, therefore, it were really a satellite, it appears probable that there are *three* satellites revolving within the orbit of I., at apparent mean distances of about 12″, 15″, and 18″.

Mr. Lassell having favoured me with a communication of all his observations of a close satellite of *Uranus*, with the position-angles estimated at the time, and copies of the diagrams, it appears from them, that only on one occasion has such an attendant been undoubtedly seen on the *southern* side of the planet. This occurred on Sept. 27, 1845, at $12^h\ 6^m$ Greenwich Mean Time. The estimated angle was 160°, the distance was 3 diameters of the planet from the edge of the disk, which gives 14″ for the central distance. This does not at all agree with any probable period of the satellite *a*. But on calculating the period of *c* from this observation, compared with each set obtained by M. O. Struve in 1847, employing as a guide to the number of entire revolutions the approximate period deduced by him, viz. $3^d\ 22^h\ 10^m$, and giving a weight to the Poulkova observations proportional to the number from which each result is derived, the period comes out from the mean of the whole,—$3^d\ 22^h\ 8^m\ 35^s$. Mr Lassell's estimation of distance corresponds to a greatest elongation of about 17″; which, as well as the period, agrees so nearly with the result of the Poulkova observations, as to render it highly probable that the satellite observed by Mr. Lassell on Sept. 27, 1845, is the same as that observed by M. O. Struve.

Extract of a Letter from M. Otto von Struve to the Astronomer Royal.

"You will see from the *Astronomische Nachrichten*, &c., that we have not been idle at Poulkova since your visit. In addition to the published accounts I have little to say, except that my father's calculations of the Great Russian Meridian Arc give a considerably larger value to the difference between the two axes of the earth than has been hitherto found. I cannot tell you the exact quantity, as the calculations are not completed.

"I have finished my observations of the satellites of *Uranus* for this season. As soon as I have a little leisure, I shall deduce their motions from the observations. I have seen the third satellite, distinctly, only once since my communication to Sir John Herschel, viz. at 6 P.M. on January 25th. Its position was 202°, its distance about 18″. I am now inclined to think that the differences of the light of this satellite in different parts of its orbit are so great, that it cannot be seen by our refractor when it is in the opposite direction to that in which I have hitherto observed it. The atmosphere was very favourable on two occasions, when the satellite was supposed to be to the north of the planet, but I could not see the least trace of it. The period of its revolution is, however, somewhat uncertain, for these *negative* observations are far from conclusive.

"M. Döllen has finished his calculations on Bessel's fundamental catalogue for 1820. The result, as respects *Procyon*, is, that the irregularity supposed by Bessel in its proper motion, vanishes altogether."

In a letter to Captain Smyth, Mr. Vallack suggests the utility of adopting the binocular construction in astronomical telescopes, and especially in Newtonian reflectors. He has himself fitted up two mirrors on this principle, and finds a considerable superiority in the pair over a single mirror. Mr. Vallack, if we understand him correctly, proposes the following arrangement. The specula are fixed in parallel tubes, and by raising the further mirror higher up in its tube, and bringing the small mirror or prism nearer to the mirror, an image is formed considerably in advance of the tube, which may be brought so near the image formed by the nearer mirror, that each may be viewed at the same time by its proper eye. The partition between the tubes and also the outer tube must be pierced, to let the rays of the more distant mirror pass out; by a little adjustment, the distance between the images may be made to suit different eyes. He remarks, as an objection to the binocular construction, that the observation will not be convenient, if objects of very different altitudes are to be viewed, but still thinks that it would be worthy of trial in certain cases.

The meetings of the Society are held at 8 P.M. on the second Friday of each month.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *April* 14, 1848. No. 6.

Capt. W. H. Smyth, R.N., Vice-President, in the Chair.

Richard Hodgson, Esq., Evesley, near Hartford Bridge, Hants; Wm. Assheton Cross, Esq., Redscar, near Preston, Lancashire; and Wm. Henry Palmer, Esq., 24 Bedford Row, were balloted for and duly elected Fellows of the Society.

FLORA.

Observations.

Cambridge. (Professor Challis.)

1847.	Greenwich M.T.	R.A.	N.PD.	
	h m s	h m s	° ′ ″	
Nov. 23	12 35 54·0	4 45 42·12	76 8 49·8	Meridian.
29	12 5 47·5	39 9·97	76 1 8·7	—
Dec. 1	11 55 42·0	36 55·99	75 57 44·9	—
7	11 25 30·2		44 59·0	—
11	12 2 5·6	26 4·39	34 5·0	Nor^{d}. Equat^{l}.
14	10 50 51·2	4 23 9·72	75 24 58·9	Meridian.

No correction has been applied for parallax. The reference star on December 11 was B.A.C. 1409, the place of which is taken from the Catalogue. The number of comparisons was six.

Elements. By W. W. Boreham, Esq.

From observations on Oct. 18, Nov. 9, and Dec. 5, 1847; all the small corrections having been taken into account.

Epoch 1848, January 0,0, G.M.T.

	°	′	″	
Mean Anomaly ...	35	42	7·64	
π	32	42	8·36	Mean Eq. 1847·0.
☊	110	19	0·04	
i	5	52	43·73	
ϕ	9	2	33·33	
Log a	0·3427149			
μ	1086″·2613			

IRIS.

Observations.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

	Greenwich M.T.			R.A.			N.P.D.			No. of Comp.		Star.
1847.	h	m	s	h	m	s	°	′	″	R.A.	N.P.D	
Dec. 8	5	43	1·6	21	23	13·93	100	10	22·3	6	4	Bessel xxi. 546
13	5	13	16·8	21	32	42·46	99	30	36·3	3	3	B.A.C. 7562
1848.												
Jan. 27	6	36	26·5	23	4	58·84	91	38	53·2	2	1	Bessel xxiii. 78
Feb. 1	7	11	7·1		15	52·95	90	36	7·8	4	3	B.A.C. 8152
2	6	49	24·5		18	1·45	90	23	30·0	9	9	— —
17	6	56	12·9	23	51	14·21	87	8	8·8	5	5	Bessel xxiii. 1004

"No correction has been applied for parallax. The places of the stars are adopted from the cited catalogues. A comparison of the observation of Feb. 17 with the place of the planet computed approximately from Professor Goldschmidt's elements, in No. 615 of the *Astronomische Nachrichten*, gave the following result:—

Cal^d R.A. — Obs^d R.A. = + 2^s·9   Cal^d N.P.D. — Obs^d N.P.D. = —0′·3″

NEPTUNE.

Observations.

CAMBRIDGE. On the Meridian. (Professor Challis.)

	Greenwich M.T.			R.A.			Obs^d—Cal^d	N.P.D.			Obs^d—Cal^d
1847.	h	m	s	h	m	s	s	°	′	″	″
Nov. 23	5	51	30·6	22	0	12·30	—0·75	102	51	16·3	+5·7
24	5	47	36·6		0	14·24	0·73		51	4·2	4·7
29	5	28	8·7		0	25·91	0·66		49	56·5	2·4
Dec. 1	5	20	22·3		0	31·28	0·83		49	26·5	3·5
6	5	0	58·8		0	47·42	0·75		47	57·0	3·4
8	4	53	14·5		0	54·92	0·54		47	16·0	1·8
13	4	33	54·8	22	1	14·81	—1·04	102	45	23·3	+2·7

With the Northumberland Equatoreal.

	Greenwich M.T.			R.A.			Obs^d—Calc^d	N.P.D.			Obs^d—Cal^d	No. of Comp.
1848.	h	m	s	h	m	s	s	°	′	″	″	
Jan. 12	5	30	42·9	22	4	14·17	—0·73	102	29	5·8	+5·3	4
15	6	9	56·8		4	36·95	0·44		27	0·0	+2·2	6
27	5	53	51·2	22	6	11·43	—0·63	102	18	21·4	—0·2	3

The reference star in all the equatoreal observations was e^2 *Aquarii*, the place of which is adopted from the British Association Catalogue. The parallax 0″·28 has been taken into account.

MAUVAIS' COMET.

Starfield. 20-foot Equatoreal. (Mr. Lassell.)

1848.		Greenwich M.T.	R.A. Comet—Star.	N.P.D. Comet—Star.	No. Obs.	Star Compared.
		h m s	m s	′ ″		
March	3	10 2 24	−0 9·48		9	H. C. 21083
		11 57 51		+4 11·8	5	—
	19	10 9 25	+0 4·00		8	*a*
		9 45 26		+3 3·3	6	—
	24	10 15 42	−0 6·44		10	B. Z. 280 R.A. $10^h 6^m 27^s$
		9 35 27		+3 50·7	8	—
	29	......	Sky became hazy.			*b*
		10 45 4		+4 18·3	4	—
	31	9 52 16	−0 2·88		9	*c*
		9 15 30		−0 33·7	7	—
April	1	......	Clouded up.			H.C. 19600 = B. ix. 1172
		11 31 10		+1 15·8	4	—
	3	9 38 14	−1 5·60		5	B. ix. 1176
		9 7 29		+3 23·2	5	—

"The results of observation are stated without any correction."

Mr. Lassell remarks that he "changed the mirror in the course of these observations, but the micrometer readings are reduced by the appropriate value. The micrometer is by Merz, with illuminated threads; powers 219 and 297."

"On March 31st, a faint nebula (R.A. $9^h 58^m 44^s$, N.P.D. 74° 53′ approx.) was almost in the field with the comet; and I estimated the comet at about half the brightness of the nebula. The comet appears to have a *very minute* stellar nucleus surrounded by nebulosity. When last seen, the comet had become a faint object, yet I think it may possibly be visible when the moon has retired."

"The observations of the 19th March were made during the total lunar eclipse; and as a very small quantity of light is sufficient to obliterate this comet, it may be inferred that the moon's disk had not, at this place, any *very* extraordinary brightness. It did not appear to me brighter than might be accounted for by its not passing centrally through the shadow."

The approximate places of Mr. Lassell's stars of comparison are subjoined, in the hope that their correct positions may be determined immediately.

Approximate Mean Places of Stars, 1848·0.

	Mag.	h m s	° ′ ″	
H. C. 21083	8	10 50 55·5	71 27 52	A star of the 9 mag. follows in $3^s{\cdot}5$, and is 4′ to the north.
a	10	10 16 10	73 14	
B. Z. 280	8·7	10 7 46·8	73 50 57	
b	8·9	9 59 20	74 29	
c	8·9	9 58 20	74 49	
H. C. 19600 Bessel ix. 1172	8·9	9 54 22·2	74 55 49	
—— 1176	8·9	9 54 40·7	75 8 15	

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis).

1847.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Comp.	Star.
March 31	10 19 20·0	9 57 22·76	74 48 48·8	5	H.C. 19600
April 1	10 15 48·3	56 4·20	74 56 52·3	3	— —
3	10 33 1·4	53 34·64	75 12 9·1	5	H.C. 19572
6	10 56 46·9	9 50 6·12	75 35 38·4	6	Bessel ix. 1074

"These observations, as well as those of March 3 and 7, already communicated (see *Monthly Notice*, vol. viii. No. 5), were made by taking angles of position and distances with a double-bar micrometer, the stars of immediate reference being (excepting on April 6), minute stars in the neighbourhood of the comet, which were afterwards compared with the reference-stars mentioned above. The power employed was 120 or 160. On account of the faintness of the object no illumination whatever could be used in addition to that afforded by the luminosity of the atmosphere, which, prevailing as it usually does about the time of the vernal equinox, made the micrometer bars sufficiently visible, and almost overpowered the comet.

The following mean positions of the stars used in the foregoing and the previous observations have been obtained by meridian observations, commencing on March 13:—

Star.		Mean R.A. 1848,0. h m s	Mean N.P.D. 1848,0. ° ′ ″
H.C.	21083	10 50 54·97	71 27 53·1
—	20827	10 41 19·27	72 3 3·2
—	19600	9 54 21·90	74 55 44·1
—	19572	9 53 8·82	75 20 40·6
Bessel ix.	1074	9 49 39·60	75 40 18·9

The three last positions have been adopted in the places here given. If the two first be used, and a corrected value of the micrometer revolution, obtained April 4, be employed, the corrections to the observations of March 3 and 7 will be respectively $-0^{s}{\cdot}31$, and $-0^{s}{\cdot}25$ in right ascension, and $-1''{\cdot}4$ and $+3''{\cdot}0$ in north polar distance. No account has been taken of parallax. All the places of the comet were obtained with great care, and I consider them entitled to confidence."

SOUTH VILLA. Equatoreal. (Messrs. Bishop and Hind.)

1848.	Greenwich M.T. h m s	R.A. ° ′ ″	Dec. ° ′ ″
April 2	11 22 35	148 41 37 + 0·35 *p*	+ 14 54 53 + 0·62 *p*

Mr. Slatter, of Rose Hill, near Oxford, communicated an account of the solar halo and parhelia which were observed so extensively on March 29 last, together with an explanatory sketch of the phenomenon as it appeared at his station.

Mr. Slatter also furnishes accounts of the auroræ which appeared on the night of the lunar eclipse (March 19 of the present year), and on the night of October 24 of the year 1847. His object is

principally to shew, by a comparison of the observations of the aurora which were made at Cambridge, at Stowe, and at Rose Hill, that the phenomenon exists within the limits of the earth's atmosphere, and is modified and perhaps partly produced by the state of vapour existing in the atmosphere at the time. The observations, he observes, are irreconcilable, on the supposition of their representing the *same phase* of the phenomena at the same time; but that they "suggest the notion of a wave of vapour driven across the country by a westerly wind, visiting each station in succession, and exhibiting the same details at each in succession."

Mr. Drach suggests that certain facts, which may be of use to shipwrecked mariners, should be printed or engraved upon articles likely to be preserved. He has furnished a specimen for the dial-plate and case of a watch, on which short tables of the equation of time, of the sun's declination, and of the acceleration, are inscribed.

SPECIAL GENERAL MEETING.

A Special General Meeting was holden after the business of the ordinary Meeting was concluded, agreeably to the Bye-laws (Sec. iv. § 9), to consider the following Resolutions, which were proposed on the part of the Council; Capt. W. H. Smyth, in the Chair:—

1. The election of the following persons as Honorary Members of the Society:—
   His Majesty the King of Denmark, in acknowledgment of the services of his predecessors.
   His Grace the Duke of Northumberland, in acknowledgment of his defraying the expense of Sir J. F. W. Herschel's work.
   Baron von Senftenberg, in acknowledgment of his foundation and maintenance of an active and useful Observatory.
2. The expulsion from the Society of Edward Jordan Graeff, Esq., William Hill, Esq., Rev. J. Michell, Thomas G. Western, Esq., Rev. William Fletcher, Captain J. Forbes, Ebenezer Henderson, Esq., Rev. Dionysius Lardner, LL.D., and J. B. Duncan, Esq., unless the arrears due by them to the Society be paid up.

The three persons above mentioned were unanimously elected (by show of hands) Honorary Members of the Society.

It having been ascertained at the commencement of the Meeting, that twenty-four Fellows were present, a ballot was taken upon each of the names mentioned in the second resolution; at the close of which the Chairman announced that the nine Fellows in question were severally expelled from the Society.

NEW PLANET,

Discovered at Mr. Cooper's Observatory, Markree Castle, Sligo, by Mr. A. Graham.

Extract of a Letter from Mr. Graham.

"In following up a class of observations recommended by Mr. Cooper I discovered a planet; the following observations are all that have been made at Markree up to the present time:—

Greenwich M.T.	R.A.	Dec.	
1848.	h m s	° ′ ″	
April 25·541	14 56 38	−12 35	Rough, from Map.
26·472888	55 34·63	31 47·5	Equat. Microm.
26·547714	55 29·94	31 37·9	Mer. Circle.
26·596244	55 27·15	31 28·1	Equat. Microm.
27·440	54 33	29	Rough Reading.
28·441448	14 53 37·60	−12 26 36·3	Equat. Microm.

"A. Graham.

"*Markree Observatory, April 29.*"

In a previous letter, April 27th, Mr. Graham announced his discovery, and estimated the planet at about the 10th magnitude.

NEW STAR IN OPHIUCHUS.

On April 28 Mr. Hind discovered, at Mr. Bishop's Observatory, a star of between the fourth and fifth magnitude, near Bessel xvi. 962, where none was noticed on April 5th. Its light in the telescope is remarkably vivid; the apparent position, April 28, was

R.A. 16h 51m 1s·24   Dec. −12° 39′ 12″·2

To the naked eye, the new star appears as bright as ν *Serpentis.* It is on the line joining η and 20 *Ophiuchi.*

In reply to some inquiries, the Editor of the Monthly Notices wishes it to be understood that the President and Council are not at all responsible for that work, which is left to his management. The author of each communication is answerable for the facts or theories stated; no alteration being made, intentionally, in this respect. The only liberty taken is that of occasional retrenchment, when required by uniformity of arrangement or limited space; and every contribution, not obviously incorrect, is noticed, which is of an astronomical nature.

Erratum.—No. 5, p. 130, line 10, *for* November, *read* October.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *May* 12, 1848. No. 7.

Sir J. F. W. Herschel, Bart., President, in the Chair.

The Rev. T. P. Dale, Rector of St. Vedart, Foster Lane; Major Thomas Vallancey Lysaght, Hingolee, India; Stephen Fenwick, Esq., Mathematical Master at the Royal Military Academy, Woolwich; and the Rev. Henry Halford Jones, of Manchester; were balloted for, and duly elected Fellows of the Society.

The following were also balloted for, and duly elected Associates of the Society:—Dr. P. H. L. von Boguslawski, Breslaw; Dr. C. Bremiker, Berlin; Dr. A. L. Busch, Königsberg; Dr. Thomas Clausen, Dorpat; Professor A. Colla, Parma; M. H. D'Arrest, Berlin; M. Daussy, Paris; M. H. Faye, Paris; Dr. J. F. G. Galle, Berlin; Dr. B. Goldschmidt, Göttingen; M. K. C. Hencke, Göttingen; Professor K. Knorre, Nicolajew; M. Laugier, Paris; Professor J. H. Mädler, Dorpat; M. Mathieu, Paris; M. V. Mauvais, Paris; Dr. C. A. F. Peters, Pulkowa; Dr. A. C. Petersen, Altona; M. K. C. Rümker, Hamburg; M. Otto von Struve, Pulkowa; M. Max. Weisse, Cracow.

METIS.

Discovered at Mr. Cooper's Observatory, Markree, Sligo, by Mr. A. Graham.

Extract of a Letter from Mr. Graham.

"Two names have been suggested to Mr. Cooper: 'Thetis,' with a wave for symbol; and 'Metis,' one of the Oceanides, with an eye for the symbol. Μητις (a *prudent plan* or *counsel*) is appropriate so far as the name is concerned, the discovery of the planet having resulted from a plan of observation devised by Mr. Cooper. He has directed me to choose, and I have selected the latter name (*Metis*). I trust, therefore, that astronomers will adopt this name, with an eye and star for symbol."

Ephemeris at Greenwich Mean Noon. By Mr. Graham.

1848.		R.A.			Decl.			Log Δ.
		h	m	s	°	′	″	
June	1	14	23	45·46	—11	22	55·1	0·24336
	2		23	9·51		22	32·6	24529
	3		22	35·03		22	17·0	24727
	4		22	2·02		22	8·5	24929
	5		21	30·52		22	7·1	25134
	6		21	8·56		22	13·0	25343
	7		20	32·14		26	26·0	25556
	8		20	5·25		22	46·2	25772
	9		19	39·92		23	13·7	25992
	10		19	16·16		23	48·5	26215
	11		18	53·97		24	30·5	26440
	12		18	33·34		25	19·7	26669
	13		18	14·29		26	16·1	26900
	14		17	56·81		27	19·7	27133
	15		17	40·90		28	30·5	27369
	16		17	26·56		29	48·4	27607
	17		17	13·78		31	13·3	27847
	18		17	2·57		32	45·3	28089
	19		16	52·92		34	24·3	28333
	20		16	44·81		36	10·2	28578
	21	14	16	38·25	—11	38	3·0	0·28825
June	22	14	16	33·23	—11	40	2·7	0·29073
	23		16	29·74		42	9·1	29323
	24		16	27·78		44	22·3	29574
	25		16	27·34		46	42·1	29827
	26		16	28·44		49	8·6	30081
	27		16	31·05		51	41·7	30335
	28		16	35·16		54	21·2	30590
	29		16	40·75		57	7·2	30846
	30		16	47·83	11	59	59·6	31102
July	1		16	56·37	12	2	58·2	31359
	2		17	6·37		6	3·0	31616
	3		17	17·81		9	13·9	31874
	4		17	30·70		12	30·8	32131
	5		17	45·00		15	53·6	32389
	6		18	0·70		19	22·2	32647
	7		18	17·79		22	56·5	32905
	8		18	36·26		26	36·5	33163
	9		18	56·09		30	21·9	33420
	10		19	17·24		34	12·7	33677
	11	14	19	39·72	—12	38	8·6	0·33934

Elements. By Mr. Graham.

Epoch 1848, April 30·0, Greenwich M.T.

M	141° 54′ 11″·82	
$\varpi -$ ☊	4 20 27·72	M. Eq. 1848, April 30.
☊	68 29 40·44	
i	5 35 23·98	
ϕ	7 13 36·92	
Log a	0·3777174	
μ	962″·5660	

Constants for the above Elements.

$x = r\,a \sin(\mathrm{A}+\nu)$ A = 162° 44′ 32″·20 + 1·003 d ☊

$y = r\,b \sin(\mathrm{B}+\nu)$ B = 75 13 7·69 + 1·010 d ☊

$z = r\,c \sin(\mathrm{C}+\nu)$ C = 61 59 21·64 + 0·889 d ☊

Log e'' = 4·4141037 log a = 9·9982090 − 0·06 d ☊

Log k_1 = 0·1596643 log b = 9·9558531 + 0·94 d ☊

Log k_2 = 0·2145892 log c = 9·6418570 − 3·55 d ☊

r being the radius vector and ν the true anomaly. These constants are calculated with an obliquity = 23° 27′ 23″, and are referred to the mean equinox of April 30.

Observations.

Markree. (MM. Cooper & A. Graham.)

Greenwich M.T. 1848.	R.A. h m s	Decl. ° ′ ″
April 29·451017	14 52 36·88 − [9·250] + Δ	−12 23 54·7 + [0·886] + Δ
May 3·407148	48 39·48 − [9·362] + Δ	13 12·6 + [0·878] + Δ
5·440066	46 33·40 − [9·203] + Δ	7 52·0 + [0·887] + Δ
5·516892	14 46 28·56	−12 7 37·8 + [0·894] + Δ

"The last was taken with the meridian circle. The planet was compared with the following stars:"—

				R.A. h m s	Decl. ° ′ ″
April 29	Bessel xiv.	1031			
May 3	——	956	H.C. 1800	14 47 47·38	−11 57 27·0
5	——	846,956	— 1800	14 46 42·65	−11 49 21·8

Altona. Meridian. (Prof. Schumacher and Dr. Petersen.)

1848.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″
May 5	11 50 46·1	14 46 31·65	−12 7 42·5
6	45 50·4	45 31·63	5 11·4
7	40 54·4	44 31·44	2 41·42
8	35 58·9	43 31·60	−12 0 12·4
9	31 3·6	42 32·12	−11 57 49·4
10	26 9·0	41 33·25	55 19·6
11	11 20 33·1	14 40 34·90	−11 53 1·1

"The three last observations are not very good on account of the faintness of the planet. The places depend on *α Virginis* and *β Libræ*, taken from the *Nautical Almanac.*"

Hamburg. Meridian. (MM. C. & G. Rümker.)

		R.A.		
1847.	Hamburg M.T. h m s	Circle. h m s	Transit. s	Dec. ° ′ ″
May 5	11 50 46·1	14 46 31·64	31·39	−12 7 47·5
6	45 50·1	45 31·35	31·35	5 16·9
7	40 54·2	44 31·22	31·06	2 45·7
8	35 58·9	43 31·64	....	−12 0 18·9
9	31 3·5	42 32·03	31·89	−11 57 52·4
10	26 9·1	41 33·29	33·60	55 29·2
11	21 14·8	40 34·77	....	53 6·9
12	16 21·3	39 37·03	....	50 55·0
13	11 27·7	38 39·15	39·31	48 39·6
14	11 6 35·2	14 37 42·46	....	−11 46 26·6

Durham. Equatoreal. (Prof. Chevallier & Mr. R. A. Thompson.)

1848.	Greenwich M.T.	R.A.	N.P.D.
	h m s	h m s	° ′ ″
May 6	10 40 46·1	14 45 32·28	102 5 12·8
8	10 52 5·7	43 31·33	102 0 7·6
9	12 2 46·4	42 28·63	101 57 32·1
10	10 56 58·4	14 41 32·38	101 55 15·3

Observations corrected for refraction only.

The star of comparison was observed on the meridian on May 9 and 10, and its place found to be,—

R.A. 14ʰ 44ᵐ 40ˢ·32 N.P.D. 102° 0′ 57″·5 8 Mag.

Hartwell. Equatoreal. (MM. Hind and Reade.)

1848.	Greenwich M.T.	R.A.	N.P.D.
	h m s	h m s	° ′ ″
May 4	10 38 19	14 47 34·24	102 10 25·0
5	10 28 35	14 46 34·10	102 7 47·9

"The star of comparison is not found either in Lalande's or Bessel's catalogues. Its apparent place was obtained by comparison with Bessel xiv. 846 and 931. The declinations deduced from comparisons with these stars differ 10″. The apparent place adopted is

R.A. 14ʰ 47ᵐ 27ˢ·54 N.P.D. 102° 1′ 33″·9

South Villa. Equatoreal. (MM. Bishop and Hind.)

1848.	Greenwich M.T.	R.A.	N.P.D.
	h m s	° ′ ″	° ′ ″
April 30	13 39 31	222 52 3·3 + 0·232 *p*	102 20 44·1 − 0·886 *p*
May 1	11 21 17	222 38 26·9 + 0·138 *p*	102 18 17·1 − 0·891 *p*

CERES.

Observations.

Hamburg. Merid. Circle & Transit. (MM. C. & G. Rümker.)

1848.	Hamburg M.T.	R.A. Mer. Circle.	R.A. Transit.	Decl.
	h m s	h m s	s	° ′ ″
March 22	11 46 55·2	11 49 11·72	....	+19 45 8·5
27	23 7·9	45 3·19	2·98	19 58 37·6
28	18 24·0	44 15·22	15·31	20 0 33·6
30	8 58·7	42 41·39	41·55	3 42·5
31	11 4 17·5	41 55·77	55·95	4 56·0
April 1	10 59 37·1	41 11·38	11·46	5 51·3
2	54 57·1	40 27·13	....	6 34·7
3	50 18·4	39 44·34	44·58	7 2·9
4	10 45 41·2	39 2·82	2·70	20 7 14·4
15	9 56 8·0	32	43·55	......
16	9 51 45·4	11 32 16·76	16·44	+19 50 43·4

PALLAS.

Observations.

HAMBURG. Merid. Circle & Transit. (MM. C. & G. Rümker.)

	Hamburg M.T.	R.A. Circle.	R.A. Transit.	Decl.
1848.	h m s	h m s	s	° ′ ″
March 17	10 51 53·3	10 34 18·09	18·27	+ 2 3 40·2
21	34 20·5	32	28·46	......
22	29 59·7	32 3·68	....	4 5 30·4
23	25 41·2	31 40·94	....	4 29 3·4
27	8 40·4	30 23·56	23·42	6 0 6·0
28	4 28·9	30 7·99	8·01	6 21 57·7
29	10 0 19·2	29	54·01	......
30	9 56 10·6	29 41·31	41·60	7 4 34·0
31	52 3·8	29 30·48	30·60	7 25 22·5
April 1	47 58·5	29 21·10	20·71	7 45 43·0
2	43 55·0	29 13·39	....	8 5 43·1
3	39 53·0	29 7·30	7·03	8 25 15·1
4	35 52·7	29 2·93	3·24	8 44 29·6
10	12 25·2	29 10·84	11·03	10 30 43·7
11	9 8 36·2	29	17·77	......
14	8 57 18·9	29	48·80	......
15	53 36·1	30 1·42	1·55	+11 47 50·5
16	8 49 55·6	10 30	16·96	......

IRIS.

Observations.

LEYDEN. 8-foot Fraunhofer. (Professor Kaiser.)

	Leyden M.T.	R.A.	No. Obs.	Dec.	No. Obs.
1847.	h m s	° ′ ″		° ′ ″	
Aug. 26	10 26 48·4	297 0 36·18	8	−13 51 29·01	4
27	8 57 13·2	296 53 12·11	12	53 7·88	6
28	9 48 8·4	296 45 27·27	12	54 50·37	6
30	9 2 43·9	296 32 11·52	12	13 58 16·71	6
Sept. 9	10 12 39·1	295 54 45·77	12	14 12 57·62	4
10	9 31 42·3	295 53 55·21	14	14 9·70	4
11	8 43 35·3	295 53 32·98	12	15 16·99	5
15	9 0 31·7	295 57 14·45	12	19 20·98	5
19	9 10 40·2	296 9 7·42	10	22 30·38	4
28	8 13 34·0	297 4 11·65	12	25 29·69	6
Oct. 2	9 45 11·7	297 41 23·79	8	24 54·10	4
	9 45 11·7	23·23	8	53·25	4
3	7 8 54·2	297 50 35·38	12	−14 24 35·07	5
	7 19 19·2	39·13	12	35·63	5

	Leyden M.T.	R.A.	No. Obs.	Dec.	No. Obs.
1847.	h m s	° ′ ″		° ′ ″	
Oct. 5	7 20 48·1	298 12 31·44	10	−14 23 35·89	7
8	7 39 33·2	298 48 24·98	8	21 25·68	4
9	7 14 53·6	299 1 1·64	10	20 33·56	4
11	6 56 3·6	299 27 33·66	8	18 28·76	3
13	7 38 55·9	299 56 9·47	12	16 4·04	4
	7 38 55·9	9·27	12	3·60	4
14	7 20 34·2	300 10 38·79	12	14 41·84	4
	7 20 34·2	40·24	12	42·04	4
15	8 32 38·5	300 26 30·25	8	13 9·37	4
	8 32 38·5	28·99	8	9·62	4
16	7 32 42·2	300 41 20·66	8	11 38·83	6
20	6 55 21·2	301 46 15·60	8	4 29·91	4
21	7 33 13·4	302 3 52·69	5	……	—
	7 54 44·0	……	..	2 20·49	3
22	7 39 39·0	302 21 32·61	10	14 0 16·80	4
26	7 4 27·1	303 34 18·03	12	13 50 30·22	5
Nov. 1	6 43 55·6	305 32 56·02	12	32 36·50	6
8	6 53 40·0	308 4 10·11	12	6 41·17	4
	7 5 3·2	21·21	12	39·08	4
9	6 57 44·5	308 26 52·63	11	13 2 28·78	5
10	6 47 1·3	308 49 30·88	14	12 58 15·83	6
18	7 23 51·2	312 8 31·60	5	……	—
19	7 20 53·4	312 33 17·36	8	2 47·68	4 D^{n} ?
21	5 39 0·5	313 14 7·16	12	12 3 37·47	5 D^{n} ?
24	6 47 44·9	314 31 56·19	11	11 45 50·66	4
29	5 51 48·2	316 42 6·98	12	14 35·28	4
Dec. 1	6 53 57·6	317 36 54·43	10	11 0 53·39	4
14	5 30 9·0	323 38 8·67	13	9 22 38·61	6
21	6 4 5·2	327 2 49·24	10	8 21 26·21	4
30	5 21 14·6	331 31 43·42	19	6 55 23·35	6
1848.					
Jan. 4	5 14 53·7	334 4 35·84	13	6 4 2·45	6
5	5 13 12·3	334 35 24·87	16	5 53 32·16	6
8	5 34 54·6	336 8 59·72	12	5 21 8·63	4
13	5 31 19·8	338 45 31·79	15	4 25 29·38	5
14	5 46 6·3	339 17 22·96	10	4 13 59·26	4
20	6 20 45·9	342 28 45·31	11	3 3 57·48	4
26	6 30 33·2	345 41 46·59	12	1 51 25·48	4
27	5 44 44·5	346 13 6·52	14	1 39 24·76	4
Feb. 1	5 40 10·1	348 55 51·78	11	−0 36 56·87	4
Mar. 3	6 51 55·0	6 18 41·59	12	+6 12 50·72	4
	7 12 6·1	19 14·00	10	13 5·33	4
4	6 51 59·7	6 53 8·27	12	6 26 22·58	5
14	7 26 54·5	12 42 34·43	11	+8 40 38·30	4

FLORA.

HAMBURG. Equatoreal. (M. C. Rümker.)

1848.	Hamburg M.T.	R.A.	Dec.	No. of Obs.
	h m s	° ′ ″	° ′ ″	
March 17	8 36 46·3	79 17 4·4	+22 54 48·2	12
19	9 15 4·3	80 9 6·0	23 2 36·5	6
20	8 2 22·2	80 33 57·4	6 21·7	14
22	8 3 37·0	81 26 21·2	13 35·1	7
23	9 3 37·2	81 54 5·7	17 17·6	5
27	8 32 18·4	83 40 55·5	30 23·4	17
28	8 40 32·6	84 8 20·4	33 35·9	10
30	8 9 50·4	85 2 38·8	39 9·6	11
31	8 29 14·8	85 30 48·0	42 2·8	13
April 1	9 21 20·0	85 59 37·0	44 56·1	6
2	8 33 28·3	86 26 29·7	47 11·7	14
3	8 27 8·1	86 54 35·7	49 41·7	17
4	8 27 49·4	87 22 56·3	23 51 53·9	13
9	8 47 19·8	89 46 5·2	24 2 13·5	10
11	8 51 24·0	90 44 9·7	5 26·5	21
14	8 58 49·7	92 11 58·2	9 26·6	25
15	9 53 11·0	92 42 23·8	10 46·0	10
16	9 2 25·5	93 10 47·2	+24 11 39·7	18

DURHAM. (Professor Chevallier & Mr. R. A. Thompson.)

				No. of Comp. in		
1848.	Greenwich M.T.	R.A.	N.P.D.	R.A.	N.P.D.	Star.
	h m s	h m s	° ′ ″			
Feb. 10	10 28 30·5	4 26 42·95	70 14 11·6	14	14	B.A.C. 1417
11	8 5 46·4	27 39·20	70 8 48·3	19	8	— —
19	8 38 54·8	......	69 20 31·6	—	5	H.C. 8844
	8 39 30·1	4 36 52·47	......	9	—	— —
Mar. 7	9 16 57·7	5 0 55·01	67 49 11·3	4	2	B.A.C. 1620

The Stars' places are taken from the Catalogues. No correction has been applied for parallax.

Observations of the Moon, and Stars near her Path.

By Professor Jahn of Leipsic.*

These observations were made on November 18, 19, 20, and December 18, in 1847, and on February 15, 1849.

By MM. C. and G. Rümker, Hamburg.

These include observations on Nov. 18, Dec. 12, in 1847, and Jan. 16, Feb. 12, 15, March 13*, 15, 17*, April 10*, 14, 15, 16*, May 8, 9, 10, 11, 12, 13, 14, 15, in 1848. For the days marked *, the declination of the moon's bright limb is also given.

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* Observations of the moon, and stars near her path, are carefully preserved, as they are not unfrequently required for corresponding observations.

Latitude of Durham Observatory.

Professor Chevallier gives as the approximate latitude of this observatory, 54° 46′ 6″·2 N., from many careful observations with his transit circle, the radius of which is one foot.

By a portable transit* placed east and west (Bessel's method), and using γ *Ursæ Majoris*, he finds:—

1848.	° ′ ″
May 4	54 46 8·6
6	4·8
9	7·7
Mean	54 46 7·0

Longitude of Poona.

(Captain Jacob's Observatory.)

From the observations inserted in the present volume, p. 133, Mr. H. Breen, of the Royal Observatory, has computed the following results, adopting the formulæ and symbols of the Astronomer Royal in the Greenwich observations, and correcting the place of the moon by a mean of the observations made with the meridian, and altitude and azimuth instruments at Greenwich.

1847.			East Long. h m s
Dec. 13	θ Aquarii	Imm.	4 55 35·79
		†Em.	32·73
16	Uranus	Imm.	33·79
		Em.	33·12
East Longitude of Capt. Jacob's Observatory			4 55 33·86

Longitude of Hartwell from Meridian Observations of the Moon.

By Mr. T. Dell.

From observations at Hartwell, compared with corresponding observations at Greenwich, Cambridge, and Oxford, in the months of October and November last, Mr. Dell deduces the following results:—

	m s		
West longitude of Hartwell,	3 24·26	by 5 comparisons with	Greenwich.
	21·32	5	Cambridge.
	23·44	5	Oxford.

The observations are all of the first limb of the moon.

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* The instrument is small, and was not very accurately adjusted. This method has not been employed much in this country, but a careful observer, *with a good level*, will obtain in this manner excellent results.

† The Emersion is printed $2^h\ 45^m\ 37^s{\cdot}9$, which Mr. Breen found to be quite inconsistent with the other observations: he has corrected this to $2^h\ 42^m\ 37^s{\cdot}0$.

EXPECTED COMET OF 1264 and 1556.

Extract of a letter from Mr. Hind.

"I believe I have been misunderstood in reference to the time of reappearance of the comet of 1556. However I may have expressed myself, I never intended to imply that, in my idea, the comet would return exactly at the end of a period of 291·7 years, which is the interval between the perihelion passages in 1264 and 1556. On the contrary, I think I am right in stating that the effect of perturbations by *Saturn* and *Neptune* during the last revolution will tend to retard its appearance, while *Jupiter* will not exercise any serious influence either one way or the other. If the mean motion in 1556 corresponded to the semi-major axis given by the interval between 1264 and 1556, the next return of the comet may very probably be delayed many months, possibly one or two years, beyond the present time. I have now in the press a small work[*] upon this comet, in which I have collected nearly all that is known of its former history, with ephemerides for the approaching return.

HIND'S CHANGING STAR.

Extracts of a Letter from Mr. Hind to the President, dated May 2, respecting the star newly discovered by him in Ophiuchus; with remarks by other astronomers.

"My acquaintance with the neighbourhood commenced in February; and I am able to state with confidence that, up to April 5, no star so bright as 9·10 magnitude had been noticed in the position of the new one. Yesterday morning I estimated it of the 5th magnitude, or equal to 20 *Ophiuchi;* it hardly appeared so bright as on April 29 A.M., but haze prevailed in many directions and may have partially obscured it. I believe I mentioned in my former letter, that a planetary disc was suspected under high magnifiers, but I am by no means satisfied with the observation. On the contrary Mr. Dawes assures me, that with Mr. Lassell's nine-foot reflector, and powers up to 600, it has nothing planetary in its appearance.

"In the appendix to the *Connaissance des Temps* for 1846, M. Biot has given a translation of Ma-touan-lin's catalogue of *Extraordinary Stars* observed in China. Amongst these I find,—

B.C. 134 in July. A strange star in the asterism formed by *β, ϖ, ϱ, &c. Scorpii.*
48 in May. A star 4° distant from *μ Sagittarii.*
A.D. 123 in December. In the region about *α Herculis* and *α Ophiuchi.*
173 December 10. Between *α* and *β Canis Minoris*, presenting "the five colours," and remaining visible until July 174.

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[*] This work has already appeared under the title, "On the expected Return of the Great Comet of 1264 and 1556." By J. R. Hind, 8vo. pp. 78. London, G. Hoby, 123 Mount Street, Berkeley Square. The ephemerides on the hypothesis of different times of perihelion passage are contained in pp. 62–67.

369 March to August.

386 April to July, in *Nan-teou* (λ, μ, φ, &c. *Sagittarii*). Remained there during the whole period.

393 March to October in the sidereal division *Ouei* (commencing at μ^2 *Scorpii* and extending 18° in right ascension): declination indeterminate.

1011 February 8. A strange star seen near the square of *Nan-teou* (σ, τ, ζ, φ *Sagittarii*). This is probably the object referred by Hepidannus to the year 1012, which was of extraordinary brilliancy, remaining visible in the southern parts of the heavens during three months.

1203 July 28. A star appeared under the sidereal division *Ouei* (∴ right ascension was greater than that of μ^2 *Scorpii*, but did not exceed it more than 18°): declination indeterminate.

1584 July 1. A strange star in the division *Fang* (∴ right ascension greater than that of π *Scorpii*, but not exceeding it more than 5°.

"I mention these stars because they appeared in the neighbourhood of the milky way, and therefore bear out the inference in your note, as to the general locality of "irregular stars." By far the greater number of the objects mentioned in Ma-touan-lin's catalogue of *Extraordinary Stars* were certainly comets, as is evident from their motion, but not appearing with trains, did not strictly come under the Chinese definition of a comet. The cases of new stars remote from the *via lactea* in this catalogue, are *very few indeed*. I never noticed this circumstance before.

"My measures of differences of right ascension and declination between the new star and Weisse xvi. 956, do not indicate any change of position.

	Sidereal Time.		
	h m	s	′ ″
April 27, at	16 36	Δα = + 14·89	Δδ = + 18 22·8
28,	15 55	= + 14·94	= + 18 21·7
May 1,	16 ±	= + 14·8	not observed.

"Professor Challis says his position, obtained on the night of the 28th, agrees exactly with mine for the previous night.

There are two small stars near the new one.

		Pos.	Dist.
		°	′ ″
a	11th mag.	249·4	7 54
b	10·11	144·5	8 49

"I had intended to repeat the micrometric measures frequently with all possible accuracy, *i.e.* supposing the star does not vanish as suddenly as it has become visible.

"Mr. Woolgar remarks 'that this particular spot must have often been examined by astronomers during the last and early part of the present century, it being within a few minutes of the site assigned to the spurious star 52 *Serpentis* * * Mr. Baily alleges that its introduction arose from a mistake in the determining star (η *Herculis* for η *Ophiuchi*).'"

"Dr. Petersen, at Altona, 'first observed the new star on April 30, and estimated it of the 6th magnitude. On May 4 he set it down as 5·6. It was carefully compared with ν *Serpentis* on May 7, and was found to be a little smaller than that star. On May 11

it was considerably fainter than ν *Serpentis* and *Piazzi* xvii. 191, and a little brighter than a star of about the 6th magnitude, the apparent place of which was observed to be,—

R.A. $17^{h}\ 1^{m}\ 26^{s}{\cdot}19$ Decl. $-10^{\circ}\ 19'\ 6''{\cdot}9$

"It has a very intense reddish-yellow light, and sometimes it appears to me that the red light becomes suddenly stronger, and as suddenly vanishes altogether.

"The apparent places of the changing star are,—

1848.	R.A. h	m	s	Decl. °	′	″	Mag.
April 30	16	51	1·23	−12	39	17·0	6
May 4			1·24			13·8	5½
7			1·42			13·8	5¼
11	16	51	1·50	−12	39	14·7	5¾

Mr. Rümker remarks "that he does not know whether it is an optical illusion, but more rays appear to issue from it, in his opinion, than from other stars.

"Mr. Graham says,—'Your star is a most curious object. We observed it with the meridian circle on the 5th. I suppose your remark had some influence on my imagination, for it seemed to me in the large equatoreal to give symptoms of a disc.'"

From a communication by Mr. Hind *to the Society dated May* 29.

"It appears that on many of our globes, and on some charts, a star, called 52 *Serpentis*, is inserted nearly in the position of the new one. 52 *Serpentis* is one of the stars which Mr. Baily has notified as having been introduced into the *British Catalogue*, through an error of calculation on the part of Flamsteed, who, Mr. Baily remarks, has employed the right ascension of η *Herculis* as a determining point, instead of that of η *Ophiuchi*. The position assigned to 52 *Serpentis*, reduced to 1848, does not exactly agree with that of the New Star; still, assuming that such a star had really been observed by Flamsteed, the differences might have originated in a great proper motion, and it therefore became a matter of importance to ascertain the precise nature of the error committed by Flamsteed, whether under any circumstances 52 *Serpentis* could have existed.

We find for 1848,0,

	R.A. h	m	s	N.P.D. °	′	″
52 Serpentis ……	16	52	34·8	102	45	58
Nova ……………	16	50	59·1	102	39	16

"Through the kindness of the Astronomer Royal I have been favoured with a view of the original calculations, &c., preserved at the Royal Observatory, Greenwich. To ascertain the right ascension of an unknown object, Flamsteed's plan was to refer it to that of some well-determined star, observed on the same day. On

1690, June 16, four stars were observed on the meridian, the first being certainly η *Ophiuchi* (as Flamsteed calls it), and not η *Herculis*, which is shewn by the zenith distances read off from the instrument. This is used by Flamsteed as a determining star for the other three, which were really ν, ξ, and ο *Serpentis*, as the observed zenith distances, and, the transits referred to η *Ophiuchi* undoubtedly prove. In fact, reducing the positions of the four stars to 1690, we find,—

		N.P.D.
	m s	° '
η Ophiuchi.......................		105 17·6
ν Serpentis follows η Ophiuchi	10 47·1	102 29·6
ξ	27 13·3	105 9·6
ο	31 22·8	102 40·0

"The observed intervals and north polar distances were,

	Interval.	Observed N.P.D. to nearest minute.
	m s	° '
η Ophiuchi...............		105 17
First Star (ν Serp.) after η Oph....	10 47	102 29
Second Star (ξ Serp.) — ...	27 39	105 9
Third Star (ο Serp.) — ...	31 23	102 39

"There appears to be some error in the observation of right ascension of ξ *Serpentis*, or in the reduction, amounting to 25^s.

Flamsteed has taken for the right ascension of η *Ophiuchi* the 'determining star' of 1690, June 16, $16^h\ 32^m\ 58^s$, and hence finds,—

	R.A.	N.P.D.
	h s m	° '
First Star	16 43 45	102 29
Second Star	17 0 37	105 9
Third Star	17 4 21	102 39

"The *first* is the spurious star 52 *Serpentis*, and the *third* another spurious star, 54 of the same constellation; but it is singular that no use whatever has been made of the *second* observation by Flamsteed, otherwise, instead of two we should have three stars introduced into the catalogue, none of which are found in the heavens.

"The right ascension adopted as a determining point, $16^h\ 32^m\ 58^s$, is not exactly that of η *Herculis*, which would in 1690 = $16^h\ 32^m\ 18^s$. Probably, therefore, all this confusion has arisen from some error of copy. In the present case it is extremely satisfactory to be able to refer to the original calculations, and shew from them that no such star as 52 *Serpentis* ever did exist. It is a practical proof of the almost imperative necessity of preserving *original* observations, notwithstanding the observer himself may fancy he has guarded against all possible sources of error in his published results.

"52 and 54 *Serpentis* should therefore be omitted in all charts and globes."

Orbit of Binary Star near μ^2 Boötis. By Mr. Hind.

"I have lately calculated another orbit for the star near μ^2 *Boötis*, my object being to ascertain what alterations would be required to represent Mr. Dawes' measures of 1846, published in the *Monthly Notices* of the Astronomical Society. The new elements are as follow:—

Perihelion Passage	1852·504	tan. $\overline{45^\circ + \frac{1}{2}\varphi} = 0{\cdot}53041$
Position of Perihelion	226° 25′	Log. $e_{,} = 3{\cdot}46058$
Node	117 21	Cos. $i = 9{\cdot}83420$
Angle between ϖ and ☊ ...	103 17	
Inclination............	46 57	
Excentricity	0·84006 = sin. 57° 8′·7	
Mean Annual Motion	−33′·245	
Semi-major Axis ..	3″·218	
Period	649$^{\text{yrs}}$·72	

Ephemeris from these Elements.

	°	″
1847·00............	282·50	0·618
1847·50............	279·52	0·591
1848·00............	276·35	0·563
1848·50............	272·84	0·532
1849·00............	268·84	0·501

"I have no observations since 1846·80 (Mr. Dawes' epoch), and therefore cannot check the orbit. This appears to be an important period; if I am not mistaken, differences in the observed angle, by no means improbable, would suffice to *shorten* the period very considerably."

On an easy Method of approximating to the distance of a Planet from the Sun by means of two Observations only, made near the Planet's opposition. By Professor Chevallier.

If v be the linear velocity of the earth, and r the distance of the planet from the sun, the earth's distance being 1, the linear velocity of the planet $= \frac{v}{\sqrt{r}}$.

Also the angular retrograde velocity of the planet at or near opposition $= \frac{1}{r-1}\left(v - \frac{v}{\sqrt{r}}\right) = \frac{v}{\sqrt{r}\,(\sqrt{r}+1)}$

Again, let L, L′, be the heliocentric longitudes of the earth at the times of observation, and l, l' the *geocentric* longitudes of the planet, and let $n = \frac{L'-L}{l-l'} = \frac{\text{Heliocentric Velocity of the Earth}}{\text{Geocentric Velocity of the Planet}}$, since the heliocentric velocity of the earth $= v$, we have $n = \sqrt{r}\,(\sqrt{r}+1)$ and $r = \frac{1}{2}\,(1 + 2n - \sqrt{1+4n})$.

Using this formula, Mr. Chevallier deduces from the Durham observations, May 6, and 10, a mean radius vector which agrees very nearly with that computed by Mr. Graham.

On a Formula for reducing Observations in Azimuth of Circumpolar Stars near Elongation, to the Azimuth at the greatest Elongation. By Captain Shortrede.

In trigonometrical surveys the direction of a chain of triangles is often deduced from the observed azimuth of a circumpolar star at its greatest elongation. The method is convenient, as an accurate knowledge of the time is not requisite, and the latitude is generally sufficiently well known. It is indeed necessary to have the polar distance of the star with the utmost precision. In the northern hemisphere, *Polaris* and *δ Ursæ Minoris* are usually employed.

When the time is known with tolerable certainty, it is much more satisfactory to observe the star frequently, both before and after its greatest elongation, and Captain Shortrede in this memoir gives a demonstration of the formula which he has found most convenient for reducing such a series of observations of azimuth to the azimuth at the greatest elongation.

He deduces an *exact* expression for the tangent of the difference of each azimuth from the greatest azimuth, in which the only variable quantities are, the time from the greatest elongation, and the arc joining the position of the star at its greatest elongation with its position at the time of observation. The formula is easy of computation, and, when many observations have been made, would greatly facilitate their reduction.

Captain Shortrede shews, that in most cases an approximate computation of the principal variable, viz. of the secant of the arc above-mentioned, would be sufficient, and that this may be very readily effected by a formula involving $\log \frac{\text{ver. sin}}{\sin 1'}$: a table of this function for all arcs up to 1^h is added to the memoir.

*On a Regulated Time-ball.** By Professor Chevallier.

"The usual method of indicating the time by a ball is by permitting the ball to fall freely, the motion being a little accelerated at first by a spring. It is evident that this method is subject to some uncertainty as to the particular instant of time which is to be observed. There is also some inconvenience arising from the derangement to which the apparatus is liable by the sudden stoppage of the motion of the ponderous ball.

"It is proposed to remedy these disadvantages by regulating the descent of the ball, so that its motion may be uniform, and causing it to pass through three or five horizontal hoops. The motion may be so regulated that the ball may pass through the distance between

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* See p. 16 of the present volume.

one hoop and another in a determinate interval, as about 20ˢ; and the mean of the times at which the ball is observed to pass the successive hoops may be taken as in the observation of the transit of a star.

"If the ball is spherical, the time of its bisection by the hoops may be noticed.

"The observer is supposed to be at some distance from the apparatus, so that his eye may not be very far distant from the plane of any of the hoops."

Notice of Errata in Standard Catalogues, communicated by M. Faye.

B. A. C. 3836 *Leonis; Hist. Cél.* 21467.

"The position of this star in the B. A. C. depends wholly on the observations contained in the *Hist. Cél.* p. 325. It has since been observed by Bessel and by myself. The mean places for Jan. 1, 1848, are,—

	R.A.			Dec.			
	h	m	s	°	′	″	
Lalande	11	6	4·87	+3	4	49·6	Error of 1′ in B. A. C. and *Hist. Cél.*
Bessel......			4·81		5	45·6	
Faye			4·73		5	50·1	

Groombridge 1867.

"On comparing the R.A. of this star with *Johnson's Observations*, 1844, and with the *Hist. Cél.*, the position in Groombridge is found to be 35ˢ in error."

Colonel Batty sent for inspection a curious dial, of the workmanship of Nicholas Kratzer, Horologier to King Henry VIII., and the friend of Holbein.

This consists of a block cut into various faces and hollows, each serving for a dial, mounted on a foot, and furnished with a plumb-line for rectification. There is a hollow on the top, which it is conjectured was meant to receive a compass. The date is 1542, and the arrangement and ornamental work very elegant.

Colonel Batty has supplied the following biographical notice of Kratzer, extracted from Bliss's edition of Wood's *Athenæ Oxonienses*:—

"Nicholas Kratz was born at Munich, and educated at the universities of Cologne and Wittenburg. He came to England with the degree of B.A., was made Fellow of Corpus Christi, Oxford, by Bishop Fox, in 1517, gave lectures in astronomy in that university on the king's order, and was appointed mathematical reader by Cardinal Wolsey.

"He seems to have written several mathematical treatises, which are still in MSS., chiefly in the Bodleian Library. One of

these, which is reputed to be his, is *De Compositione Horologionum*.

"He made the old dial which is now in the garden of Corpus, and another standing on a pillar in the churchyard of St. Mary's. He was living in the year 1550, and after his death many of his books came into the hands of Dr. John Dee, and some into those of Dr. Richard Forster."

Lunar Eclipse of March 19, 1848.

Extract of a Letter from the Rev. Charles Mayne, Killaloe.

"The eclipse was observed with an excellent 30 inch telescope of 2 inches aperture, fixed pretty firmly to the window sash. Nothing particular was noted at first. The moon was seen well at intervals between clouds for an hour and a half, and then was completely covered. Some considerable time after, one of the family going to the window exclaimed, 'the eclipse is over!' I went to the window and saw the *whole* of the moon, the colour much like that of tarnished copper, *i. e.* of a dullish red, some parts being darker than others. After looking at it for some time, I perceived with great surprise that the eclipsed part was marked, but (from the general effect produced on the moon) only indistinctly. Clouds soon after covered the whole sky, and the moon was not again visible till about a quarter of an hour before the end, when the appearance was as usual, the eclipsed part nearly black and the rest perfectly bright. I am told that *aurora* was visible the same night.

Captain Jacob has forwarded a considerable catalogue of double stars observed by him at Poona in the years 1845–8, with a 5-foot equatoreal by Dollond.

In accordance with the desire expressed by Sir John Herschel, Captain Jacob has transmitted drawings of the solar spots observed at Poona in the month of March last.

Erratum in the Monthly Notice for March, p. 126.

The observations of *Flora* at the Durham Observatory are corrected for *refraction* but not for *parallax*.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. VIII. *June* 9, 1848. No. 8.

Capt. W. H. Smyth, Vice-President, in the Chair.

The late Dr. Pearson bequeathed to the Society all the stock of *Introduction to Practical Astronomy* remaining unsold at his death. There are about 100 copies of the entire work, and 400 copies of the first volume, which contains the tables.

The Council have resolved to sell these at the following prices to fellows and associates of the Society:—

	£	s.	d.
The whole work, 2 vols. text, and 1 of plates	1	1	0
The 1st vol., containing all the tables	0	5	0

The price to non-members is double.

It is desirable that those fellows who wish to purchase the work should give immediate notice to the Assistant-secretary.

FLORA.

Observations compared with Mr. Hind's Ephemeris in the *Monthly Notices*, Nos. 2 and 3 of Vol. VIII.

Cambridge. On the Meridian. (Professor Challis.)

1848.	Greenwich M.T. h m s	R.A. h m s	Obs^{d}—Cal^{d} s	N.P.D. ° ′ ″	Obs^{d}—Cal^{d} ″
Jan. 4	9 15 22·9	4 10 13·43	+0·07	73 55 9·0	−0·7
5	9 11 14·5	10 0·88	+0·27	49 58·3	+2·1
11	8 47 12·0	9 33·78	−0·23	73 17 10·1	−1·7
15	31 57·5	10 3·06	+0·17		
16	8 28 14·4	10 15·84	+0·03	72 48 22·6	+3·0
Feb. 1	7 33 30·0	18 27·35	−0·62		
2	7 30 21·2	4 19 14·59	−0·61		

With the Northumberland Equatoreal.

1848.	Greenwich M.T.	R.A.	Obsd—Cald	N.P.D.	Obsd—Cald	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s	s	° ′ ″	″			
Feb. 16	7 31 53·7	4 33 12·62	−0·61	69 38 33·0	− 1·8	1	1	*a*
	8 3 27·1	13·92	0·86	31·3	+ 4·3	9	9	*b*
	8 31 54·9	15·34	0·83	24·4	+ 4·5	1	1	*c*
17	7 49 47·9	34 24·35	−0·97	32 42·4	+ 7·6	1	1	*c*
	8 1 30·9	34 26·28	+0·38	26·3	− 5·6	3	3	*d*
18	7 20 48·3	35 36·80	+0·41	69 26 44·3	− 4·3	6	6	*d*
25	8 19 1·5	44 42·22	−1·03	68 46 36·8	− 1·2	6	6	*e*
28	10 31 22·3	49 1·51	0·66	29 50·4	+ 2·4	6	6	*f*
Mar. 3	10 42 10·8	4 54 52·24	1·19	68 8 48·1	− 2·4	7	7	*f*
10	8 32 17·5	5 5 36·15	1·02	67 35 11·9	5·9	9	9	*g*
14	9 6 45·3	12 10·94	0·97	17 13·7	12·6	8	8	*h*
18	9 24 9·3	18 57·40	1·04	67 0 43·3	15·8	6	6	*i*
20	8 8 36·9	22 18·51	1·55	66 53 21·3	9·0	1	1	*j*
	8 40 43·5	21·15	1·24	12·6	12·7	12	5	*k*
21	8 7 50·0	24 3·19	1·38	49 45·1	3·0	1	1	*j*
	8 26 41·2	4·61	1·33	28·7	16·5	10	10	*k*
28	7 46 5·4	36 32·43	0·70	26 24·4	− 8·2	2	2	*l*
29	8 27 22·7	38 24·81	1·10	23 35·4	+ 4·4	8	8	*m*
April 1	8 9 23·9	43 56·10	0·75	15 17·5	− 2·3	9	6	*n*
6	9 30 53·3	5 53 26·75	0·97	66 3 28·2	− 5·7	7	7	*o*
10	10 42 42·1	6 1 12·71	0·75	65 56 9·7	+ 4·1	7	7	*p*
14	8 20 5·2	8 47·42	0·93	50 22·4	−12·0	9	9	*q*
17	8 45 2·8	14 43·32	0·59	47 17·3	9·7	2	2	*r*
	8 48 12·2	43·50	0·66	17·9	9·0	9	9	*s*
19	9 2 24·3	18 41·61	0·95	45 41·0	15·0	1	1	*t*
	9 12 49·9	42·63	0·82	41·3	14·2	8	8	*u*
28	8 55 38·6	36 42·74	0·54	44 31·1	9·8	10	5	*v*
	8 55 38·6	42·34	0·94	27·0	13·8	10	6	*w*
29	8 27 59·7	6 38 41·80	0·47	65 44 55·2	10·8	2	2	*x*
	8 53 54·6	43·90	−0·56	53·1	−13·4	7	7	*v*

"The observed places are corrected for refraction and parallax, and the calculated places for aberration.

"The mean places of the following reference stars were derived from the authorities cited below, by applying the annual and secular variations. Where two authorities are mentioned, the mean of the two results is adopted :—

a... B.A.C. 1417
c H.C. 8705; B.Z. 343: $4^h\ 27^m\ 33^s$
d... H.C. 8798
e... H.C. 9228; 9229
f... B.A.C. 1551
g... B.A.C. 1620
j... H.C. 10208
l... B.A.C. 1801
m H.C. 10844; B.Z. 348: $5^h\ 34^m\ 46^s$
n H.C. 11048; B.Z. 348: $5^h\ 40^m\ 4^s$
o... H.C. 113 56; B.Z. 348 : $5^h\ 50^m\ 17^s$
p... B.A.C. 1981
q... B.A.C. 2011
r... B.A.C. 2042
t... B.Z. 348 : $6^h\ 14^m\ 7^s$

"The star *x* is B.A.C. 2238, the adopted mean place of which, 1848·0, as determined by one transit and two circle observations in 1847, is R.A. 6h 42m 46s·01, N.P.D. 66° 13′ 25″·4.

"The remainder are unknown stars, the following adopted apparent places of which, obtained by one, or at most by two, equatoreal comparisons with the known stars, can only be regarded as approximate:—

Star.	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″	By Comparison with
b	4 32 26·64	69 41 49·7	H.C. 8705
h	5 11 35·04	67 19 56·5	B.A.C. 1620
i	5 18 7·33	67 1 44·5	H.C. 10208
k	5 21 51·77	66 54 38·7	— —
s	6 13 58·77	65 48 16·2	B.A.C. 2042
u	6 17 44·43	66 11 9·9	B.Z. 348, 6h 14m 7s
v	6 36 20·58	65 43 19·8	B.A.C. 2238
w	6 37 13·04	65 45 30·0	— —

MARKREE. Meridian Circle. (E. J. Cooper, Esq. & Mr. Graham.)

Greenwich M.T. 1847. d	R.A. h m s	Decl. ° ′ ″	Parallax.
Nov. 17·569130	4 51 40·14	+13 47 9·0	+[9·810] *p*
25·541658	43 32·45	13 53 22·1	9·809
30·524187	38 1·65	14 0 34·0	9·808
Dec. 3·513676	34 40·71	14 6 6·9	9·807
18·462247	19 33·41	14 48 53·2	9·800
20·455666	17 56·35	14 56 25·5	9·800
30·424155	11 51·88	15 39 54·0	9·792
1848. Jan. 3·412267	10 28·25	15 59 42·3	9·788
5·406488	10 0·68	16 10 4·2	9·787
11·389680	9 34·29	16 42 49·3	9·781
14·381822	9 52·68	16 59 59·5	9·779
15·379396	10 3·24	17 5 48·1	9·778
19·369046	11 8·54	17 29 30·8	9·774
24·356887	13 17·89	17 59 53·0	9·768
25·354526	13 50·02	18 6 0·6	9·767
28·347583	15 38·09	18 24 34·6	9·764
31·340835	17 43·22	18 43 12·2	9·761
Feb. 12·315677	28 42·16	19 57 9·0	9·747
15·309798	32 2·66	20 15 13·3	9·744
25·291212	44 37·85	21 12 53·0	9·733
26·289433	4 46 0·28	+21 18 23·0	+[9·732] *p*

NOTES.

1848.
Jan. 11. Bad illumination; observation uncertain in consequence. Got 5 wires.
15. Got but 4 wires. Clouded at first three.
19. Very faint. Seen through clouds.
25. A 9½ mag. star (same declination) about 15s following.
Feb. 25. Very faint.

Equatoreal and Square-bar Micrometer.

Greenwich M.T.		R.A.	Parallax.	Decl.	Parallax.
1847.	d	h m s		° ′ ″	
Oct.	27·493196	5 3 52·43	−[8·498] *p*	+13 54 44·5	+[9·843] *p*
Nov.	2·606546	2 5·93	[7·437]	13 49 43·9	9·810
	5·481421	5 0 43·81	[8·461]	13 48 4·4	9·837
	17·470484	4 51 46·70	[8·371]	13 47 11·8	9·827
	19·489789	49 49·73	[8·251]	13 48 4·1	9·819
	25·496986	43 35·23	[8·048]	13 53 25·1	9·813
	27·424133	41 29·05	−[8·324]	13 55 47·0	9·822
1848.					
Feb.	2·413464	19 19·11	+[8·286]	18 55 59·1	9·776
	9·366218	25 37·55	[8·061]	19 39 6·0	9·757
	11·500694	27 48·56	[8·580]	19 52 6·1	9·832
	17·461166	34 33·83	[8·540]	20 27 58·6	9·808
	18·484396	35 47·74	[8·579]	20 34 2·1	9·826
	28·399010	48 58·49	[8·440]	21 29 50·5	9·771
March	1·402994	4 51 50·79	[8·463]	21 40 27·3	9·774
	7·341941	5 0 49·66	[8·254]	22 10 14·3	9·739
	24·412996	29 29·41	[8·568]	23 21 5·0	9·796
	25·388964	31 14·07	[8·527]	23 24 17·2	9·777
	27·413143	34 53·05	[8·576]	23 30 33·2	9·800
	28·388962	36 39·58	[8·537]	23 33 35·8	9·779
	30·429934	40 24·07	[8·602]	23 39 22·4	9·817
	31·507438	42 23·78	[8·624]	23 42 24·0	9·891
April	8·451371	5 57 21·60	[8·627]	24 0 34·4	9·848
	10·444793	6 1 12·83	[8·626]	24 3 57·2	9·848
	13·412816	6 57·87	[8·607]	24 8 18·9	9·818
	24·441495	29 48·65	[8·632]	24 15 51·4	9·857
	25·441903	30 48·93	[8·632]	24 15 57·0	9·859
	26·409492	32 45·29	[8·619]	24 16 1·5	9·830
	29·415226	6 38 49·76	+[8·625] *p*	+24 14 57·8	+[9·892] *p*

Stars of Comparison and Notes.

1847.			
Oct. 27	Bessel	v. 54	Sixteen comparisons.
Nov. 2	—	11	Eleven comparisons.
5	—	11	H. C. 9671, 9714.
17	—	iv. 1199	H. C. 9417. *Flora* appears to have occulted a minute star about the time of culmination.
19	—	1081, 1086, 1096.	Weisse gives for the right ascension of this last 4h 48m 27s·63; it should be 4h 48m 26s·63, as I have taken it in the reduction. Baffled by clouds. Instrument greatly shaken by wind.
25	B.A.C.	1500	H. C. 9074.
27	—	—	Do.
1848.			
Feb. 2	—	1376	The instrument was greatly shaken by the wind, and I fear even moved in right ascension: so that there is little confidence to be placed in this observation.
9	—	1417	Piazzi v. 119, 120.
11	—	—	— — — The planet is becoming much fainter. This night I estimate it at not more than 9½ magnitude. Strong moonlight, however.

1848.
Feb. 17 B.Z. 343; 4^h 32^m 22^s·00. H. C. 8844. *Flora* rapidly diminishes in magnitude. It cannot to-night be more than 10^m.

18 — — Another star, H.C. 8798, with which the planet was compared, gives for the planet's place—

4^h 35^m 50^s·12 + 20° 34′ 18″·2

It was judged safer to adopt the former determination from a star in which Lalande and Bessel agree so closely.

28 B.Z. 393; 4^h 45^m 41^s·03. H. C. 9228, 9229. Four comparisons. Clouds and wind. The latter, it is to be feared, affected the observation.

March 1 B.A.C. 1551.

7 B.Z. 334; 5^h 0^m 35^s·20. The star B.Z. 334, 5^h 0^m 33^s·71, was also taken at the same time. It gives for the planet—

5^h 0^m 48^s·65 + 22° 10′ 16″·0

The former star was much more favourably situated for the comparison: and we therefore inserted in the text the result from it, instead of taking a mean. Nine comparisons. Planet 10½ magnitude. There was a haze which rendered the planet barely visible. Cannot depend on this observation.

24 B.A.C. 1774.
25 B.A.C. 1774 B.Z. 521; 5^h 31^m 8^s·20.
27 B.Z. 348; 5^h 34^m 35^s·74, and 5^h 34^m 46^s·34.
28 Same stars.
30 B.Z. 348; 5^h 37^m 26^s·60, and 5^h 37^m 22^s·30.
31 — — 5^h 37^m 26^s·60. Two comparisons. Very low, and very faint. Lost in cloud after two comparisons.

April 8 H. C. 11589. Near the moon. Very faint. Cannot depend on this observation.
10 B.Z. 348; 6^h 2^m 55^s·40, and 6^h 2^m 55^s·99. Five comparisons. Strong moonlight. Light clouds. Planet faint.
13 B.A.C. 2011, B.Z. 348, 6^h 4^m 36^s·30. Eight comparisons.
24 B.Z. 348; 6^h 27^m 4^s·16. The star and planet were unfavourably posited for comparison.
25 Same star. Five comparisons. Interrupted by clouds.
26 B.Z. 348; 6^h 33^m 0^s·79
29 — — 6 36 45 ·93

When not otherwise mentioned in the notes ten comparisons were made in each observation.

ASTRÆA.

SOUTH VILLA. Equatoreal. (MM. Bishop and Hind.)

1848.	G.M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
June 29	12 47 13	328 56 5·1 − 0·402 *p*	−11 27 35·2 + 0·861 *p*
30	12 18 43	328 52 36·2 − 0·452 *p*	−11 29 47·7 + 0·853 *p*

"An ephemeris will appear in the *Berliner Jahrbuch* for 1851. The planet has just become visible in the morning, and we have with great difficulty obtained the following observations. The planet is not brighter than a star of the 12th magnitude.

"It is hoped that an ephemeris of *Hebe* will be ready before she can be observed.

IRIS.

Ephemeris at her Reappearance, 1848. By Mr. Hind.

"The following ephemeris of this planet up to November 11, is founded upon elements calculated from the observations at Mr. Bishop's Observatory on August 13, 1847; Dr. Wichmann's with the Königsberg Heliometer, on November 7; and Professor Challis' latest observation, 1848, February 17. The observed positions were corrected for aberration and parallax; but the effect of planetary perturbations on the geocentric place during the interval, being very minute, has been neglected.

Epoch 1847, August 1·0, Greenwich Mean Time.

	° ′ ″	
Mean Longitude of *Iris*	331 24 20·57	M.E. Aug. 1.
π	41 31 19·71	
☊	259 44 45·91	
i	5 28 15·26	
φ	13 19 59·98	
Log a	0·3772589	
μ	964″·091333	

"These elements represent the middle declination exactly, and give the right ascension too small by 0″·8. On comparing them with the latest observation which I have yet seen, viz. Professor Kaiser's on March 14, (published in a recent number of the Society's *Monthly Notices*), I find the following errors:—

$$\text{Cos.}\,\delta \times \Delta\alpha = -2''\cdot37 \qquad \Delta\delta = -5''\cdot11$$

"These differences being so very small, it appeared to me probable that any attempt to correct the orbit from a combination of the observations during the first apparition of *Iris* only, would hardly repay the trouble that must necessarily be expended upon it. I have therefore delayed the final investigation until after the next appearance of the planet. The two oppositions can then be connected, and the elements resulting from a discussion of all the observations will no doubt be sufficiently exact to form the basis for ephemerides for some time to come.

"Assuming, therefore, that the orbit just given applies to Greenwich mean noon of 1847, August 1, I have calculated the perturbations produced by *Venus*, the *Earth*, *Mars*, *Jupiter*, and *Saturn*, between this date and 1849, February 3, (nearly the epoch of opposition), employing the same values for the masses as are now adopted by Encke in his investigations on the comet which bears his name; their logarithms are,—

Venus	4·39595
Earth and Moon	4·44916
Mars	3·5718
Jupiter	6·97969
Saturn	6·45573

"The united effects of these planets, between 1847, August 1, and 1849, February 3, are,—

$$\int d\alpha = +0{\cdot}00053771$$
$$\int de = +0{\cdot}000302365$$
$$\int d\varpi = +\ 295''{\cdot}282$$
$$\int d\mathrm{L} = +\ 146\ {\cdot}486$$
$$\int d☊ = -\ \ 76\ {\cdot}789$$
$$\int di = -\ \ \ 7\ {\cdot}232$$

"For the ephemeris subjoined the true elements were obtained for every 24th day, and interpolated with 4th differences, where sensible, for every 8th day. The geocentric places so obtained were interpolated with 4th differences for each day. For the sake of brevity the elements of the variable ellipse are here given for the extreme dates of the ephemeris only:—

	Aug. $7^{d}{\cdot}0$	Nov. $11^{d}{\cdot}0$
	° ′ ″	° ′ ″
M	29 28 26·64	55 9 7·09
ϖ	41 35 29·24	41 36 55·13
☊	259 45 41·02	259 45 51·44
i	5 28 14·30	5 28 11·39
ϕ	13 20 0·25	13 20 33·03
Log. μ	2·9841593	2·9840273

"The longitudes are referred to the apparent equinox of date; corrections being applied for diminution of obliquity, &c. The ephemeris contains the position of the planet, for the apparent equinox and equator of each date, unaffected with aberration; consequently, before comparing with apparent places, it will be necessary to subtract the time given in the last column from the mean time of observation.

Ephemeris.

At Greenwich Mean Noon.

1848.		R.A.	Decl.	Log. Δ	$497^{s}{\cdot}8 \times \Delta$
		° ′ ″	° ′ ″		m s
August	7	104 51 34·7	+22 11 17·8	0·43794	22 44·6
	8	105 27 11·3	22 6 11·3		
	9	106 2 40·5	22 0 57·2	0·43679	22 40·9
	10	106 38 2·0	21 55 35·4		
	11	107 13 15·9	21 50 6·3	0·43560	22 37·2
	12	107 48 22·0	21 44 29·7		
	13	108 23 20·2	21 38 45·9	0·43437	22 33·4
	14	108 58 10·5	21 32 54·8		
	15	109 32 52·8	21 26 56·7	0·43310	22 29·4
	16	110 7 27·2	21 20 51·6		
	17	110 41 53·3	21 14 39·6	0·43178	22 25·3
	18	111 16 11·4	+21 8 20·8		

1848.		R.A. ° ′ ″	Decl. ° ′ ″	Log. Δ	$497^{s}\cdot8 \times \Delta$ m s
August	19	111 50 21·0	+21 1 55·4	0·43042	22 21·1
	20	112 24 22·3	20 55 23·3		
	21	112 58 15·1	20 48 44·8	0·42900	22 16·7
	22	113 31 59·3	20 41 59·8		
	23	114 5 35·0	20 35 8·6	0·42755	22 12·3
	24	114 39 2·0	20 28 11·1		
	25	115 12 20·2	20 21 7·4	0·42604	22 7·7
	26	115 45 29·6	20 13 57·8		
	27	116 18 29·9	20 6 42·2	0·42448	22 2·9
	28	116 51 21·2	19 59 20·9		
	29	117 24 3·2	19 51 53·9	0·42288	21 58·0
	30	117 56 36·1	19 44 21·3		
	31	118 28 59·6	19 36 43·3	0·42122	21 53·0
Sept.	1	119 1 13·7	19 28 59·9		
	2	119 33 18·2	19 21 11·3	0·41951	21 47·9
	3	120 5 13·2	19 13 17·6		
	4	120 36 58·5	19 5 18·8	0·41775	21 42·6
	5	121 8 34·3	18 57 15·0		
	6	121 40 0·3	18 49 6·5	0·41594	21 37·2
	7	122 11 16·6	18 40 53·2		
	8	122 42 23·1	18 32 35·3	0·41407	21 31·6
	9	123 13 19·7	18 24 12·9		
	10	123 44 6·5	18 15 46·1	0·41215	21 25·6
	11	124 14 43·4	18 7 15·0		
	12	124 45 10·3	17 58 39·7	0·41017	21 20·0
	13	125 15 27·2	17 50 0·3		
	14	125 45 34·0	17 41 17·0	0·40814	21 14·0
	15	126 15 30·8	17 32 29·7		
	16	126 45 17·4	17 23 38·7	0·40605	21 7·9
	17	127 14 54·0	17 14 44·0		
	18	127 44 20·3	17 5 45·7	0·40390	21 1·7
	19	128 13 36·3	16 56 44·0		
	20	128 42 41·8	16 47 38·9	0·40170	20 55·3
	21	129 11 36·8	16 38 30·7		
	22	129 40 21·2	16 29 19·4	0·39944	20 48·8
	23	130 8 55·0	16 20 5·2		
	24	130 37 17·9	16 10 48·0	0·39712	20 42·1
	25	131 5 30·1	16 1 28·1		
	26	131 33 31·2	15 52 5·5	0·39473	20 35·3
	27	132 1 21·3	15 42 40·3		
	28	132 29 0·2	15 33 12·8	0·39229	20 28·4
	29	132 56 28·3	15 24 42·9		
	30	133 23 44·9	15 14 10·9	0·38978	20 21·3
Oct.	1	133 50 50·2	+15 4 36·9		

1848.		R.A.	Decl.	Log. Δ	$497^{s}\cdot8 \times \Delta$
		° ′ ″	° ′ ″		m s
Oct.	2	134 17 44·0	+14 55 0·9	0·38720	20 14·1
	3	134 44 26·3	14 45 23·2		
	4	135 10 56·9	14 35 43·7	0·38456	20 6·7
	5	135 37 16·0	14 26 2·6		
	6	136 3 23·2	14 16 20·1	0·38187	19 59·7
	7	136 29 18·8	14 6 36·1		
	8	136 55 2·6	13 56 50·9	0·37910	19 51·7
	9	137 20 34·5	13 47 4·5		
	10	137 45 54·4	13 37 17·0	0·37628	19 43·9
	11	138 11 2·4	13 27 28·5		
	12	138 35 58·3	13 17 39·2	0·37339	19 36·1
	13	139 0 42·1	13 7 49·2		
	14	139 25 13·6	12 57 58·6	0·37044	19 28·1
	15	139 49 32·8	12 48 7·5		
	16	140 13 39·5	12 38 16·1	0·36741	19 20·0
	17	141 37 33·6	12 28 24·4		
	18	141 1 15·0	12 18 32·5	0·36432	19 11·8
	19	141 24 43·6	12 8 40·5		
	20	141 47 59·4	11 58 48·6	0·36117	19 3·5
	21	142 11 2·0	11 48 56·9		
	22	142 33 51·4	11 39 5·5	0·35795	18 55·0
	23	142 56 27·4	11 29 14·7		
	24	143 18 50·0	11 19 24·3	0·35465	18 46·4
	25	143 40 58·9	11 9 34·9		
	26	144 2 54·0	10 59 46·1	0·35129	18 37·7
	27	144 24 35·1	10 49 58·4		
	28	144 46 2·0	10 40 11·8	0·34785	18 28·9
	29	145 7 14·6	10 30 26·5		
	30	145 28 12·7	10 20 42·5	0·34436	18 20·0
	31	145 48 56·3	10 11 0·0		
Nov.	1	146 9 25·1	10 1 19·2	0·34079	18 11·0
	2	146 29 39·1	9 51 40·1		
	3	146 49 38·1	9 42 2·8	0·33716	18 2·0
	4	147 9 22·0	9 32 27·5		
	5	147 28 50·5	9 22 54·2	0·33346	18 52·8
	6	147 48 3·7	9 13 23·2		
	7	148 7 1·3	9 3 54·5	0·32970	17 43·6
	8	148 25 43·2	8 54 28·4		
	9	148 44 9·2	8 45 4·9	0·32587	17 34·2
	10	149 2 19·2	8 35 44·3		
	11	149 20 13·1	+8 26 26·4	0·32197	17 24·8

NEPTUNE.

Observations.

Cambridge. On the Meridian. (Prof. Challis.)

1848.	Greenwich M.T.	R.A.	Obs^d.—Cal^d.	N.P.D.	Obs^d.—Cal^d.
	h m s	h m s	s	° ′ ″	″
July 12	14 52 57·0	22 17 48·37	−0·93	101 17 47·9	+4·3
13	48 56·8	17 44·04	−1·01	101 18 14·8	+5·5
15	14 40 56·3	22 17 35·30	−0·99		

"The observations are compared with Mr. Adams's Ephemeris, and parallax is taken into account.

Hamburg. Equatoreal. (M. Rümker.)

1848.	Hamburg M.T.	R.A.	N.P.D.
	h m s	h m s	° ′ ″
July 4	12 44 53·0	22 18 19·92	101 14 43·1
6	12 25 51·0	22 18 12·95	101 15 29·3

Ephemeris for Greenwich Mean Midnight. By Mr. Adams.

1848.	R.A.	N.P.D.	1848.	R.A.	N.P.D.
	h m s	° ′ ″		h m s	° ′ ″
July 1	22 18 30·41	101 13 31·3	July 26	22 16 42·92	101 24 19·9
2	27·22	51·2	27	37·59	51·3
3	23·92	14 11·7	28	32·20	25 23·1
4	20·52	32·8	29	26·75	55·2
5	17·02	54·4	30	21·24	26 27·6
6	13·42	15 16·5	31	15·68	27 0·2
7	9·72	39·2	Aug. 1	10·06	33·1
8	5·92	16 2·5	2	16 4·39	28 6·3
9	18 2·03	26·2	3	15 58·67	39·8
10	17 58·05	50·5	4	52·90	29 13·4
11	53·97	17 15·2	5	47·08	29 47·3
12	49·81	40·5	6	41·22	30 21·5
13	45·56	18 6·2	7	35·32	55·8
14	41·21	32·4	8	29·38	31 30·3
15	36·79	59·0	9	23·41	32 5·0
16	32·28	19 26·1	10	17·40	39·8
17	27·69	53·7	11	11·36	33 14·8
18	23·02	20 21·6	12	15 5·28	49·9
19	18·27	50·0	13	14 59·18	34 25·1
20	13·44	21 18·9	14	53·06	35 0·4
21	8·53	48·1	15	46·91	35 35·9
22	17 3·55	22 17·7	16	40·74	36 11·4
23	16 58·50	47·7	17	34·56	47·0
24	53·37	23 18·1	18	28·36	37 22·6
25	22 16 48·18	101 23 48·8	19	22 14 22·14	101 37 58·3

	R.A.			N.P.D.				R.A.			N.P.D.		
1848.	h	m	s	°	′	″	1848.	h	m	s	°	′	″
Aug. 20	22	14	15·91	101	38	34·0	Oct. 3	22	10	6·07	102	1	55·4
21			9·66		39	9·7	4		10	1·73		2	19·1
22		14	3·42			45·5	5		9	57·49			42·2
23		13	57·16		40	21·2	6			53·34		3	4·8
24			50·91			56·9	7			49·28			26·9
25			44·65		41	32·6	8			45·32			48·5
26			38·39		42	8·2	9			41·45		4	9·4
27			32·14			43·8	10			37·69			29·8
28			25·89		43	19·4	11			34·02			49·6
29			19·66			54·8	12			30·46		5	8·9
30			13·44		44	30·1	13			27·00			27·5
31			7·23		45	5·3	14			23·65			45·5
Sept. 1		13	1·05			40·3	15			20·40		6	3·0
2		12	54·88		46	15·2	16			17·26			19·8
3			48·73			49·9	17			14·23			36·0
4			42·62		47	24·4	18			11·32			51·5
5			36·52			58·8	19			8·51		7	6·4
6			30·46		48	33·0	20			5·82			20·7
7			24·43		49	6·9	21			3·25			34·3
8			18·43			40·6	22		9	0·79			47·3
9			12·47		50	14·1	23		8	58·44			59·6
10			6·55			47·3	24			56·22		8	11·2
11		12	0·67		51	20·3	25			54·12			22·2
12		11	54·83			53·0	26			52·13			32·5
13			49·04		52	25·4	27			50·27			42·1
14			43·29			57·5	28			48·53			51·0
15			37·59		53	29·3	29			46·91			59·2
16			31·95		54	0·8	30			45·42		9	6·7
17			26·36			32·0	31			44·06			13·5
18			20·83		55	2·8	Nov. 1			42·82			19·6
19			15·35			33·2	2			41·71			25·0
20			9·94		56	3·3	3			40·72			29·7
21		11	4·59			33·0	4			39·87			33·7
22		10	59·30		57	2·2	5			39·14			36·9
23			54·09			31·1	6			38·55			39·5
24			48·94			59·6	7			38·08			41·3
25			43·86		58	27·7	8			37·74			42·4
26			38·85			55·3	9			37·53			42·8
27			33·92		59	22·5	10			37·45			42·4
28			29·07	101	59	49·2	11			37·50			41·4
29			24·30	102	0	15·4	12			37·68			39·6
30			19·62			41·1	13			37·99			37·0
Oct. 1			15·02		1	6·4	14			38·44			33·8
2	22	10	10·50	102	1	31·1	15	22	8	39·01	102	9	29·9

1848.	R.A.	N.P.D.	1848.	R.A.	N.P.D.
	h m s	° ′ ″		h m s	° ′ ″
Nov.16	22 8 39·71	102 9 25·2	Nov.24	22 8 50·12	101 8 21·4
17	40·55	19·8	25	52·02	8 10·1
18	41·52	13·6	26	54·04	7 58·2
19	42·63	6·7	27	56·20	45·5
20	43·86	8 59·1	28	8 58·49	32·1
21	45·23	50·8	29	9 0·90	18·0
22	46·73	41·7	30	22 9 3·45	102 7 3·1
23	22 8 48·36	102 8 31·9			

Horizontal Parallax.

July 1, 0″·29; Sept. 1, 0″·30; Nov. 1, 0″·29.

METIS.

Observations.

Markree. Meridian Circle. (E. J. Cooper, Esq. & Mr. Graham.)

Greenwich M.T. 1848.	R.A.	Decl.	Obsr.	Obsn.—Ephemr.	
	h m s	° ′ ″		s	″
April 26·547714	14 55 29·94	−12 31 33·1	A.G.	−0·14	+0·5
May 5·516892	46 28·56	12 7 33·0	,,	−0·11	+0·5
9·503206	42 29·15	11 57 35·9	,,	0·00	−0·1
10·499796	41 30·31	55 14·8	,,	+0·12	−1·4
12·492931	39 33·80	50 38·2	,,	−0·01	+0·5
13·489599	38 36·48	48 26·7	,,	−0·04	0·0
16·479386	35 48·93	42 17·0	,,	+0·06	−0·9
19·469431	33 8·59	36 47·0	,,	−0·11	−0·7
22·459488	30 36·86	32 3·4	,,	−0·44	−0·6
26·446062	27 30·60::	27 6·0	E.J.C.	−0·51	−2·1
29·436763	25 23·90	24 25·7	,,	−0·66	−1·2
June 2·424054	14 22 54·15	−11 22 23·7	,,	−0·91	+1·6

May 5. Very faint. Did not appear larger than a 10th mag. star.
9. Very faint.
10. Excessively faint.
13. Do.
16. Very difficult. Near the moon. Got only three wires. Corrected an error of 2ˢ in the third wire.
19. Well shewn, and well taken.
22. Faint.
26. Seen with extreme difficulty. Got but two wires. The second of these seems to have been an illusion, and was rejected.
29. Extremely faint. Got the whole seven wires; but as the centre wire was marked "very doubtful" in the observing book, and differs 1ˢ from the mean, it was omitted in the reduction.
June 2. Extremely faint.

With the large Equatoreal, Square-bar Micrometer.

Greenwich M.T. 1848.	R.A. h m s	Decl. ° ′ ″	Obsr.	Obsn. — Ephem. R.A. s	Obsn. — Ephem. Decl. ″
April 26·472888	14 55 34·58	−12 31 46·3	A.G.	+0·08	− 0·6
26·596244	27·26	26·9	,,	−0·06	− 1·2
28·441448	53 37·48	26 31·6	,,	+0·25	− 6·5
29·451017	52 36·77	23 50·0	,,	+0·24	− 9·0
May 3·407148	48 36·84	13 8·0	,,	+0·10	− 3·5
5·440066	46 33·30	12 7 47·3	,,	−0·01	− 1·8
12·451285	39 36·48	11 50 52·9	,,	+0·26	− 8·5
13·440015	38 39·33	48 37·0	,,	−0·01	− 3·6
*18·448766	34 2·12	38 33·5	,,	−0·33	+ 0·4
*19·436960	33 10·42	36 48·1	,,	+0·03	+ 1·5
25·499828	28 13·08	27 53·8	,,	−0·48	+12·4
29·495979	25 21·69	24 28·5	,,	−0·49	− 6·6
29·504334	21·63	34·5	E.J.C.	−0·21	−12·9
June 2·467104	22 53·27	22 40·3	,,	−0·30	−15·6
3·461207	22 19·34	22 25·4	,,	−0·62	−13·1
5·479031	21 15·37	22 21·7	,,	−0·91	−14·9
5·489616	15·25	20·7	A.G.	−0·72	−13·9
15·516338	17 32·00	29 19·2	,,	−1·45	−10·2
19·522799	16 47·11	35 37·6	E.J.C.	−1·47	−19·9
20·458465	16 40·00	37 17·7	,,	−1·68	−17·8
28·469008	14 16 35·39	−11 55 34·7	,,	−2·14	+ 1·5

These are corrected for Parallax.

Stars of Comparison and Notes.

1848.

April 26. Bessel xiv. 1066, H. C. 27376. Planet 10th mag.

28. — — 1031, Interrupted by clouds.

29. — — 1031.

May 3. — — 956, H. C. 27247. I used for Lalande's R.A. 47^{s}·38, instead of what is given in the British Catalogue. A mistake of 2^{s}·5 which occurred in the reduction, as formerly published, is here corrected.—See Astron. Society's *Notices*, p. 149. The planet was faint when we commenced, twilight being too strong. I fancied the planet to-night 9½ magnitude. Interrupted by clouds.

5. — — 846, 956, H. C. 27211.

12. — — 697, 735. I was struck with a faint point a little below *Metis*, about the same R.A.

13. — — 697, 735. Strong moonlight and flying clouds made the observation very difficult.

18. — — 622, 625. The planet appeared to me quite as bright as the former of these two stars, which Bessel makes 9th magnitude.

19. — — 622, 625. The latter of these two stars is 4848 of the B.A. Catal., where there is decidedly an error of 4^{s} in the R.A. A subsequent observation with the meridian circle, on May 25th, gives for the mean place 1848·0, 14^{h} 33^{m} 48^{s}·05, 101° 34′ 53″·8: thence the correction of the catalogue would be −3^{s}·95 +0″·78. Adopting this place of 625, we obtain for the planet,

May 18	14^{h} 34^{m} 2^{s}·32	−11° 38′ 41″·7
19	33 10 ·61	36 56 ·3

1848.
May 25. B.A.C. 4828. Having been apprehensive of an error in the place of this star, I observed it thrice with the meridian circle, and adopted the place thus obtained. There is very little difference, however.

B. A. C. gives	14h 28m 13s·20	−11° 27′ 56″·6
Rümker	12·91	58·8
Markree obs. (as above)	13·02	58·4

29. Bessel xiv. 424. H. C. 26484. Five comparisons each observer.
June 2. — — — Planet faint. Milky atmosphere.
5. — — — Five comparisons each observer. Planet very fairly shewn.
15. — — 259. H. C. 26265. The planet was so excessively faint in the strong moonlight, that no dependence can be placed in the observation. Took seven comparisons. There is a typographical error in Weisse, xiv, 296, the declination, should be −10° 11′ 0″·0 instead of −11° 11′ 0″·0.
19. — — 259. Nine comparisons.
20. — — 259. Satisfactory observation, though planet rather faint.
28. — — 278. Only two comparisons, and these very uncertain.

There have always been ten comparisons made in each observation, unless when the contrary is expressly mentioned.

CAMBRIDGE. On the Meridian. (Prof. Challis.)

1848.	Greenwich M.T.	R.A.	No. of Wires.	N.P.D.
	h m s	h m s		° ′ ″
April 30	12 14 55·6	14 51 32·35	5	102 20 46·6
May 1	9 59·8	50 32·36	7	18 2·5
2	5 3·2	49 31·51	3	15 25·3
3	12 0 6·8	....	...	12 47·1
4	11 55 10·6	47 30·40	7	10 10·4
5	50 15·0	46 30·50	5	7 32·6
6	45 18·6	45 29·80	4	5 2·8
7	40 22·7	44 29·72	7	102 2 31·4
8	35 27·0	43 29·76	6	101 59 55·2
9	30 31·9	42 30·38	6	57 34·9
10	25 37·2	41 31·40	5	55 16·4
11	20 43·0	....	...	52 59·7
12	15 49·2	....	...	50 40·1
13	10 56·1	38 37·56	7	48 23·7
15	11 1 11·5	....	...	44 3·8
18	10 46 41·3	....	...	38 28·9
22	27 34·6	....	...	32 7·8
23	22 50·5	29 49·60	6	30 25·4
27	10 4 5·3	26 47·59	6	26 1·7
30	9 50 15·5	24 45·21	4	....
31	45 41·7	24 7·23	5	101 23 12·1
June 5	23 14·3	21 18·91	3	....
6	9 18 47·6	14 20 48·00	3	....

With the Northumberland Equatoreal.

1848.	Greenwich M.T.	R.A.	N.P.D.	No. of Comp.	Refer. Star.
	h m s	h m s	° ′ ″		
April 30	11 5 31·2	14 51 35·28	102 20 52·4	12	*a*
May 1	11 23 9·7	50 33·87	18 10·3	7	*b*
2	12 42 39·1	49 29·76	15 25·4	6	*a*
3	11 31 57·5	48 32·11	12 52·8	6	*a*
4	12 49 14·6	47 28·35	10 8·4	6	*b*
6	13 14 1·9	45 26·00	102 4 46·6	6	*c*
12	12 17 40·6	39 32·80	101 50 37·6	6	*d*
15	12 13 31·2	36 42·50	44 15·3	6	*d*
16	12 4 22·1	33 47·46	42 12·2	6	*e*
24	13 13 2·3	28 56·96	29 13·5	7	*f*
30	11 17 5·6	24 42·79	23 40·5	6	*g*
June 5	10 53 44·8	21 15·75	22 8·0	6	*h*
6	10 39 4·8	14 20 46·84	101 22 14·1	5	*h*

"The above observations and those on the meridian are all corrected for parallax by means of Mr. Luther's Ephemeris in the *Astronomische Nachrichten*, No. 640. The following are the adopted mean places of the reference stars, determined by meridian observations:—

	Star.		Mean R.A. 1848,0.	Mean N.P.D. 1848,0.
			h m s	° ′ ″
(*a*)	Bessel xiv.	956	14 50 24·13	102 9 17·8
(*b*)	—	931	49 19·39	102 1 19·3
(*c*)	—	896	47 28·50	102 35 9·6
(*d*)	—	697	37 29·67	101 42 31·0
(*e*)	B.A.C.	4848	33 47·95	101 34 52·6
(*f*)	Bessel xiv.	523	28 30·93	100 58 38·9
(*g*)	—	498	27 11·49	101 4 37·3
(*h*)	—	424	14 23 6·94	101 11 26·1

The seconds of the R.A. of the star (*e*) in the British Association Catalogue should be 54·56 instead of 58·56.

HAMBURG. Merid. Circle & Transit. (MM. C. & G. Rümker.)

1848.	Hamburg M.T.	R.A. Mer. Circle.	R.A. Transit.	N.P.D.
	h m s	h m s	s	° ′ ″
May 5	11 50 46·1	14 46 31·64	31·39	102 7 47·5
6	45 50·1	45 31·35	31·35	5 16·9
7	40 54·2	44 31·22	31·06	2 45·7
8	35 58·9	43 31·64		102 0 18·9
9	31 3·5	42 32·03	31·89	101 57 52·4
10	26 9·1	41 33·29	33·60	55 29·2
11	21 14·8	40 34·77		53 6·9
12	16 21·3	39 37·03		50 55·0
13	11 11 27·7	14 38 39·15	39·31	101 48 39·6

1848.		Hamburg M.T. h m s	R.A. Mer. Circle. h m s	N.P.D. ° ′ ″
May	14	11 6 35·2	14 37 42·46	101 46 26·6
	21	10 32 51·1	31 28·90	33 41·4
	22	28 5·0	30 39·36	32 13·0
	23	23 21·7	29 50·86	30 54·0
	24	18 39·0	29 3·94	29 32·6
	26	9 16·4	27 32·75	27 5·7
	27	10 4 36·9	26 49·18	26 15·2
	30	9 50 46·7	24 46·33	23 51·7
June	1	9 41 40·0	14 23 31·31	101 22 46·5

With the Equatoreal.

June	1	10 52 4·4	14 23 29·66	101 22 46·0
	3	11 13 37·9	14 22 20·15	101 22 17·6

Elements.

By Dr. Brunnow of the Bilk Observatory.

		° ′ ″	
M	....	147 20 27·9.	1848, May 12. Berlin M.T.
ϖ	....	68 34 21·5	Mean Equinox.
☊	....	66 35 47·8	1848, Jan. 1.
i	....	6 10 7·6	
φ	....	10 6 49·5	
μ	....	961″·2567	

From Observations of April 26, South Villa.
,, May 5, Hamburg.
,, May 11, Bilk.

By Dr. B. A. Gould.

		° ′ ″	
M	....	142 51 34·9.	1848, May 0. Berlin M.T.
ϖ	....	72 12 3·7	
☊	....	68 35 3·0	
i	....	5 33 55·9	
φ	....	7 3 32·9	
μ	....	962″·9598	Period 1345^{d}·85

Ephemeris at Greenwich Mean Noon. By Mr. Graham.

1848.		R.A. h m s	N.P.D. ° ′ ″	Log. Δ
July	11	14 19 39·72	102 38 8·6	0·33934
	12	20 3·51	42 9·8	34190
	13	20 28·58	46 16·0	34446
	14	20 54·93	50 27·1	34702
	15	21 22·53	54 43·1	34957
	16	14 21 51·37	102 59 3·7	0·35211

1848.	R.A.	N.P.D.	Log. Δ
	h m s	° ′ ″	
July 17	14 22 21·43	103 3 29·0	0·35464
18	22 52·70	7 58·8	35717
19	23 25·17	12 33·0	35969
20	23 58·82	17 11·5	36220
21	24 33·63	21 54·1	36471
22	25 9·60	26 40·8	36720
23	25 46·72	31 31·6	36969
24	26 24·96	36 26·3	37216
25	27 4·32	41 24·9	37463
26	27 44·78	46 27·2	37708
27	28 26·33	51 33·1	37953
28	29 8·97	103 56 42·6	38196
29	29 52·68	104 1 55·5	38438
30	30 37·44	7 11·7	38679
31	31 23·24	12 31·2	38919
August 1	32 10·07	17 53·9	39157
2	32 57·91	23 19·6	39394
3	33 46·76	28 48·2	39630
4	34 36·59	34 19·7	39864
5	35 27·39	39 53·9	40097
6	36 19·15	43 30·8	40329
7	37 11·87	51 10·1	40559
8	14 38 5·52	104 56 51·9	0·40788

ENCKE'S COMET. By Mr. Hind.

"An ephemeris for the reappearance of Encke's Comet during the ensuing autumn has been published in the *Astronomische Nachrichten* by Prof. Encke.

"At the last return of the comet to perihelion, in 1842, only four observations were obtained; two at Rome by Prof. De Vico, on July 9 and 14; one at Philadelphia by Mr. Walker, on July 4; and one at Washington, on July 14, by Prof. Coffin. Encke finds for the mean error of the ephemeris in that year,

July $10^{d}\cdot 6$ R.A. $-\,37''\cdot 5$ $\delta\,+\,7''\cdot 0$

"The elements for 1848, given by Encke, are those resulting from his last discussion in Nos. 488 and 489 of the *Astronomische Nachrichten*, brought up to the next perihelion passage by the application of planetary perturbations and the effect of a resisting medium. The fundamental elements depend on all the observations made in the years 1818, 1825, 1828, 1835, and 1838, the mass of the planet *Mercury* having been corrected by the observations of 1838. In 1835, on the 23d of August, the comet approached that planet within 0·12 of the earth's mean distance; but it appears that a much closer appulse will take place about midnight on the 22d

of November next, when the distance between the two bodies will not exceed 0·038; consequently, the observations of 1852 and subsequently will afford the means of determining the mass of *Mercury* with very considerable accuracy.

"The elements for 1848 are,—

Epoch 1848, Nov. 26·125, Mean Paris Time.

	° ′ ″	
Mean Anomaly	0 0 3·046	
μ	1076″·46749	
	° ′ ″	
ϕ	57 58 34·38	
π	157 47 7·78	Mean Equinox, 1848, Nov. 26.
☊	334 22 11·53	
i	13 8 35·84	

"An ephemeris has been calculated from these elements by M. d'Arrest with every regard to accuracy; it extends from September 0 to November 27. An abstract of this ephemeris for September is here given, but in a somewhat different form to that adopted by M. d'Arrest. The epoch is 15^h mean time at Greenwich, and the positions are reckoned from true equinox of date, but are not affected with aberration.

1848.	True R.A.	True N.P.D.	Hor. Par.	Time for Aberr.
	h m s	° ′ ″	″	m s
Sept. 0	3 27 31·66	56 45 14·5	7·67	9 12
2	32 11·23	56 0 58·9	7·97	8 51
4	37 5·55	55 14 42·3	8·30	8 30
6	42 16·96	54 26 13·2	8·64	8 10
8	47 48·28	53 35 20·5	9·01	7 50
10	3 53 42·58	52 41 53·1	9·42	7 30
12	4 0 3·94	51 45 37·4	9·83	7 10
14	6 57·26	50 46 21·0	10·31	6 51
16	14 27·91	49 43 52·9	10·82	6 31
18	22 43·36	48 38 3·0	11·37	6 13
20	31 52·28	47 28 45·7	11·96	5 54
22	42 5·56	46 16 0·3	12·60	5 36
24	4 53 36·58	45 0 5·1	13·29	5 19
26	5 6 42·03	43 41 25·2	14·05	5 1
28	21 42·27	42 21 1·6	14·85	4 45
30	5 39 1·63	41 0 36·1	15·72	4 29

The intensity of light, supposed to be represented by $\frac{1}{r^2 \Delta^2}$, will be

Sept. 0	0·30
14	0·68
28	1·90
Oct. 12	5·85
26	9·86
Nov. 9	9·17
23	8·77

Expected Comet of 1264 *and* 1556.

For information respecting this comet, and for ephemerides on the hypothesis of different times of perihelion passage, see Mr. Hind's pamphlet, *On the expected Return of the Great Comet of* 1264 *and* 1556, by J. R. Hind, 8vo. pp. 78. London, G. Hoby, 123 Mount Street, Berkeley Square.

Parabolic Elements of the First Comet of 1847. By Mr. Pogson.

The following orbit is calculated upon the observation at Mr. Bishop's observatory on February 7th, the daylight positions obtained at the same observatory on March 30, and the Berlin observation of April 24; thus embracing the whole period of visibility. The elements of this comet appear to differ sensibly from a parabola:—

T 1847, March 30·27725, Greenwich Mean Time.

	° ′ ″	
π	276 2 43·7	Mean Equinox, 1847·0
☊	21 42 45·3	
i	48 39 33·6	
Log. q	8·628571	

Motion direct.

Corrections of the Elements of the Moon's Orbit, deduced from the Lunar Observations made at the Royal Observatory of Greenwich, from 1750 *to* 1830. By G. B. Airy, Esq., Astronomer Royal.*

"The reductions of the Greenwich Lunar Observations, lately published by the Lords Commissioners of the Admiralty, present the results of a series of observations, to which scarcely any thing similar exists, and to which nothing similar can be furnished for many years to come. The whole number of observations of right ascen-

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* The title of the work referred to in Mr. Airy's Memoir is *Reduction of the Observations of the Moon, made at the Royal Observatory, Greenwich, from* 1750 *to* 1830. *Computed by order of the Lords Commissioners of the Treasury, under the superintendence of G. B. Airy, Esq., M.A., Astronomer Royal. Published by order of the Lords Commissioners of the Admiralty.* London, 1848. 2 vols. 4to.

The Lords of the Admiralty, with their wonted liberality, have placed a large number of copies of this important work at the disposal of the Royal and of the Royal Astronomical Societies. It is understood that they will be presented to those public bodies and scientific gentlemen to whom the Greenwich Observations are given. As there is a difficulty in transmitting such articles, it is requested that application should be made for them at the apartments of the Society, or at least that information should be given as to the most convenient channel. It is proper to mention here, what might otherwise probably be unnoticed, that the Reduction of the Greenwich Lunar Observations is due to the suggestion of the Astronomer Royal himself, and that his direction and superintendence have been gratuitous. This was also the case with the Greenwich Planetary Reductions, published two or three years ago.

sion of the moon which are thoroughly reduced is 9067. Of these 674 are not accompanied by trustworthy observations in north polar distance (the observations being sometimes wanting, sometimes inaccurate in character, as in the method of observation called *per segmentum*, and sometimes vitiated by the faults of adjustment of the quadrant): leaving 8393 observations, complete in both elements, and as good as the nature of the instruments permitted. All these observations are used in the investigations which form the subject of this paper. These observations have been reduced with a labour proportionate to their importance. Much care has been used in planning the form of the reductions, and no pains have been spared in insuring their accuracy in every detail. The results are exhibited in a form which makes it comparatively easy for any person occupied with empirical reductions from observations to investigate the co-efficient of any inequality of any periodic time whatever. I trust, therefore, that the utility of these reductions will not be limited to the investigation of the corrections which I now beg leave to lay before the Royal Astronomical Society.

"The deductions from the reduced observations which have the first claim on our attention are, evidently, the corrections of those elements which enter as arbitrary constants in the mechanical theory of the moon's motion, and the corrections of the most important results of theory, on which, from the slowness of convergence of series, or from the practical difficulty of picking up every sensible term, some doubt may yet exist. The former are, the moon's epoch of longitude and mean motion, the excentricity and epoch of anomaly, and the inclination and epoch of argument of latitude. The latter are, the motion of anomaly (depending on the progression of the apse), the motion of argument of latitude (depending on the regression of the node), the variation, the evection, and the annual equation. But there are also other terms which demand particular attention, as depending upon other elements which are not of an arbitrary character, though their values are not precisely known. These are the equations of long period in the longitude and in the elements of latitude of the moon (depending on the ellipticity and internal constitution of the earth), the parallactic equation (depending on the proportion of the moon's mean distance to the sun's mean distance), and the constant term of the moon's parallax (depending in part on the proportion of the moon's mass to the earth's mass). All these terms are clearly pointed out by the nature of the case as demanding our first attention in the discussion of the reduced observations.

"In preparing the last section of the printed work, the importance of these deductions was kept in view. Through every part of the tabular exhibition of the comparison of observed and theoretical places of the moon, there are exhibited the corresponding values of the principal inequalities affecting the moon's place in every observation, each increased by a constant for the purpose of making it always positive. In the comparison of observed and theoretic longitudes the quantities thus exhibited are, (1), The Elliptic Inc-

quality; (2), Its change for a change of $0^s\cdot 1$ ($\frac{1}{4000}$ part of the circumference) in argument; (3), The Parallactic Inequality; (4), The Variation; (5), Its change for a change of $0^s\cdot 1$ in argument; (6), The Annual Equation; (7), The Evection; and (8), Its change for a change of $0^s\cdot 1$ in argument. Of these, the 5th is necessary only in case the correction of moon's longitude should be very large; and the 8th is necessary only in combination with the 2d, as the argument of evection is necessarily dependent on the argument of elliptic inequality. In the comparison of observed and theoretical ecliptic north polar distance, the quantities exhibited are (9), The Effect of mean Inclination; (10), Its change for a change of $0^s\cdot 1$ in argument; (11), The Evection in Ecliptic North Polar Distance. The equations of long period in the longitude and in the elements of latitude are not exhibited, because the corrections of those equations can be deduced by a simple process from the corrections of the other quantities, when the latter are determined from groups of observations whose divisions have respect to the changes of the equations of long period. The effects of alterations in the mean motions of longitude, of anomaly, and of argument of latitude, are not exhibited, because the corrections of these quantities can be deduced from the values of the corrections of epoch, of anomaly, and of argument of latitude, obtained at distant times.

"Omitting the effect of errors in all inequalities except those I have mentioned, every comparison gives an equation of condition in which the inequalities under consideration enter with their proper coefficients.

"The theoretical longitudes and ecliptic north polar distances with which the observed longitudes and ecliptic north polar distances are compared, are computed by Plana's theory, as far as regards the terms retained and their co-efficients (on which the most ample information will be found in the introduction to the *Reduction of Lunar Observations*), and from Damoiseau's tables as far as regards epochs and mean motions of every kind. Corrections to coefficients must, therefore, be applied to Plana's co-efficients, and corrections to epochs and mean motions must be applied to Damoiseau's epochs and mean motions."

The Astronomer Royal remarks, that the most legitimate mode of solving these equations of condition would be by the method of least squares; but the enormous trouble, the chance of numerical errors, and the necessity of checking the processes of calculation, have induced him to prefer the selection of groups, in which each unknown quantity enters with its positive or negative values. The immense number of recurrences of the incommensurable periods of the various equations running through such a long time makes this process very satisfactory, except in the case of variation and parallactic equation, of which the arguments depend on the difference of mean longitude between the sun and moon. As there are very few observations near conjunction, a modification is adopted in the mode of grouping the equations for those inequalities, which is a

good approximation to the method of least squares. The several groups of equations, with their respective solutions, are then given.

The Astronomer Royal then proceeds to shew in detail, how from his groups of equations the corrections of various constants are obtained. In some cases the observations shew a form not yet indicated by theory.

We have here only room for the results of this skilful handling of such apparently unmanageable masses.

1.*

Correction of Moon's Epoch of Longitude and Mean Motion.

Epoch of mean longitude, 1814 Jan. 1, 0^{h} Greenwich mean time	$44^{g}\ 23^{\prime}\ 98^{\prime\prime}\cdot 2$
Motion in 365 days	143 76 08 ·88
Motion in 100 Gregorian years	327 45 86 ·20

2.

Equation depending on the elliptic form of the earth.

The whole of this inequality, the argument of which is the mean place of the moon's node, is

$$+6''\cdot 35 \text{ sin. long. moon's node } -0''\cdot 97 \text{ cos. long. moon's node.}$$

The latter term is not recognised by theory, but its existence does not admit of doubt. The value seems well ascertained.

3.

Equation of the centre.

Coefficient of the sin. mean anomaly when the true longitude is expressed in a function of the mean longitude, as in Damoiseau's form............ $=22639''\cdot 14$

Also the correction to the moon's longitude =

$$\{-0''\cdot 31 \text{ cos. long. node } +0''\cdot 94 \text{ sin. long. node}\} \text{ sin. mean anomaly.}$$

4.

Correction of the epoch and motion of mean anomaly.

True epoch of anomaly for 1788, Jan. 1, 0^{h} Greenwich mean time	$= 110^{g}\ 59^{\prime}\ 47^{\prime\prime}$
Motion of anomaly in 100 Gregorian years which appears very certain	= 206 39 80

The corrections to the moon's longitude =

$$\{+0''\cdot 19 \text{ cos. long. node } +1''\cdot 65 \text{ sin. long. node}\} \text{ cos. mean anomaly.}$$

5.

Small terms depending on combinations of the mean anomaly and the longitude of node.

They may be put under this form:

$$+0''\cdot 66 \text{ sin. (mean anom.} + \text{long. node)} -0''\cdot 38 \text{ cos. (mean anom.} + \text{long. node)}$$
$$-0\ \cdot 98 \text{ sin. (mean anom.} - \text{long. node)} +0\ \cdot 56 \text{ cos. (mean anom.} - \text{long. node)}$$

---

[*] When the correction is to be applied to Damoiseau, it is given in *grades*, &c.; *i. e.* the circumference is divided into 400 grades, each grade into 100 parts, marked ', and each 1' into 100 parts marked 1". This notation will be a sufficient guide.

6.

Correction of the coefficient of parallactic equation.

Corrected coefficient = 122″·37, but this is uncertain.

An empirical inequality would render the observations more accordant, but this has no probable physical foundation. The more likely cause for the observed irregularities is a change in the estimation of the moon's semi-diameter, depending on changes in the telescope or in the observer. From the law of the inequality this coefficient will always be somewhat uncertain.

7.

Correction of the coefficient of variation.

Corrected coefficient = 2370″·98, which is somewhat uncertain, as depending in part on the estimated semi-diameter of the moon.

8.

Correction of the coefficient of annual equation.

True coefficient = 670″·29, pretty certain.

9.

Correction of the coefficient of evection.

True coefficient = 4586″·88, very certain.

10.

Determination of the correction to the constant term of parallax, remarks on the latitude of Greenwich, and on subjects related to it.

The Astronomer Royal here enters into a discussion which cannot be made intelligible if compressed.

The *whole* of the observations shew an error in the constant term of horizontal parallax, *i.e.* that it should be increased by 1″·78: the constant term would in this case be 3424″·94.

But the earlier and the later groups give different values of this correction, and again the colatitude in the earlier and later reductions is differently assumed. For the first 15 years, Bessel's colatitude, 38° 31′ 20″·40, was adopted, and for the last 16 years Airy's, 38° 31′ 21″·93, or somewhat more. Between these periods the colatitude may be said to have been assumed to increase uniformly, for Olufsen's index-errors of the quadrant, which have been followed, are obtained by comparing the places observed with those of the *Tabulæ Regiomontanæ*, which are interpolated between Bradley's places, colatitude 38° 31′ 20″·40, and Bessel's, which agree with those obtained by a latitude somewhat greater than 38° 31′ 21″·93.

The Astronomer Royal rejects the hypothesis of a real change in the colatitude owing to *partial* disturbances in the earth, as contradicted by the geological character of the country; and a change in the direction of the vertical from a *general* cause would disturb the sea-level in some parts of the world 100 feet. Neither is it possible, as he shews, from the admirable accordance of various modern observations, that any error can exist in the modern latitude of Greenwich. The solution of the difficulty is probably to

be found in the original imperfections of the Greenwich Quadrant,* and in its gradual degradations.

The Astronomer Royal, after proposing the best hypothesis of error which he can suggest, and bringing the later Cambridge and Greenwich observations to bear on the subject, concludes by saying, that probably Plana's constant term of parallax should be a little increased, and the moon's mass be correspondingly diminished. He proposes in the future reductions at Greenwich to increase Burckhardt's parallax by $\frac{1}{1200}$ part.

11.

Correction of the inclination of the moon's orbit: terms of long period in the inclination of the moon's orbit.

Inclination of the orbit $= 18535''\cdot46$, very certain.

Inequalities of long period =

$-0''\cdot82$ cos. long. node $\quad -2''\cdot02$ sin. long. node.

12.

Correction of the argument of latitude, and of the motion of the argument: terms of long period in the argument.

Epoch 1782, Jan. 1, 0^h Greenwich mean time, Argument of latitude	=	117^{g}	70'	14''
Motion in 100 Gregorian years	=	76	44	12

Inequalities in argument of latitude =

$+25''\cdot71$ cos. long. node $\quad -7''\cdot56$ sin. long. node.

13.

Small terms in the moon's latitude produced by the combination of the small terms of long period in the inclination and in the argument of latitude.

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* Mr. Airy says, "Science is not always progressive; and this remark applies with great force to the construction of astronomical instruments. Long ago Roemer proposed a circle almost precisely similar to that now mounted in the Oxford Observatory. Flamsteed's mural arc, extending from the pole to the south horizon, was one step backwards. The Greenwich mural quadrant, scarcely extending beyond the zenith, was another and an enormous step backwards. The artistical talents of Graham and Bird, which, by the perfection that they introduced in the details of their instruments, gave popularity to a construction that is radically bad, may be considered as the greatest misfortune that has happened to astronomy. They undoubtedly retarded the progress of accurate astronomy for half-a-century." These remarks are unquestionably true, and it is difficult to conceive how Roemer's discoveries and successful practice should have been so much overlooked; but surely the persons to blame are the successive *Astronomers Royal*, Halley, Bradley, and Maskelyne, whose business it was to direct the kind of instrument to be constructed, and not to trust implicitly to the artist. Halley introduced the transit after Roemer, with whom he probably was acquainted. Horrebow's book, which appeared in 1735, must have been known to Bradley and Maskelyne. As it is in Latin, we might excuse the artists more completely if it were not illustrated with very tolerable plates.

As a confirmation of the remark of the Astronomer Royal, we may mention here that the solstitial circle described by Ptolemy, and probably invented by Eratosthenes, bears a close resemblance to the Greenwich mural circle; and that all the practical astronomers after this time seem to have misunderstood the proper construction of their tools till Roemer.

Neglecting two insignificant terms, and combining the rest with the term $-8''\cdot00$ sin. u, adopted in the theoretical calculations, the inequality depending on the earth's figure =

$$+2''\cdot17 \text{ cos. } u \quad -8''\cdot75 \text{ sin. } u.$$

The first term is not recognised by theory, but its existence is undoubted, and the magnitude approximate.

14.

Correction of the coefficient of evection in ecliptic north polar distance.

The corrected coefficient appears to be $527''\cdot26$, but the probability that this is more accurate than the present coefficient, $527''\cdot5$, is very small.

"The deductions which have here been drawn from the *Reduced Lunar Observations* are probably all that can be inferred from the annual groups which are printed at the end of that work. For examining into the existence or corrections of terms with different arguments, it will be necessary to refer to the individual observations as reduced. This operation will never be very laborious.

"An examination of the equations in the earlier part of this paper will shew that, in each equation, every term (except that which has been expressly formed with a large coefficient,) might have been neglected, without introducing important inaccuracy into the determination of the one unknown quantity affected by that large coefficient. In other words, when the changes of sign of an inequality are determined, it is only necessary to group the values of "excess of observed longitude," or "excess of observed ecliptic north polar distance," omitting all other numbers. The process therefore will be, assuming the inequality to depend upon the sine, to determine all the times when the argument has the values 0^g and 200^g; and, finding the mean of all the "excesses" between 0^g and 200^g, and the mean of all the "excesses" between 200^g and 400^g, to subtract the latter from the former, and to multiply the difference by $\frac{\pi}{4}$. If the inequality depend upon the cosine, the divisions of groups must be made for arguments 100^g and 300^g. If two arguments are closely related, it may be necessary to use some extraordinary caution, in the same manner as for the annual equation and variation."

Mr. Maclear has sent "the mean places of the 65 stars compared with Mauvais' second comet (*Mem.* R.A.S. vol. xv. pp. 244–7), together with their apparent places on the day of comparison."

"The stars compared with the comets of Wilmot and Gambart have been observed, and the reductions are in a forward state. These and the observations of Gambart's comet will be transmitted in the course of next month. The observations of *Neptune* will follow as soon as they can be got ready. The list of stars which Professor Mädler requested to have observed is nearly ready."

On the Difference in Longitude between the Observatory of Paramatta and Port M'Quarrie. By Capt. O. Stanley, R.N.

Captain Stanley employed ten chronometers, and transported them with the utmost care, avoiding all tremulous motion which might affect their going. He and Lieutenant Gule each carefully ascertained the error of the working watch at Sydney and Paramatta, and so obtained independent results, which are as follow:—

	Difference of Longitude.
By Captain Stanley........................	52^{s}·89
Lieutenant Gule	52 ·85

This arc was measured by Sir Thomas Brisbane and M. Rümker, and again by Sir James Ross. Their results are 52^{s}·74 and 52^{s}·41 respectively.

Captain Stanley remarks, that there is a very perceptible personal equation between Lieutenant Gule and himself, in getting the time by equal altitudes with the sextant. Thus the errors of the working watch were, according to the two observers,—

		Capt. Owen. h m s	Lieut. Gule. h m s	Personal Eq^{r}. s
Sept. 1	Sydney	6 52 31·52	6 52 31·89	0·37
2	Paramatta	51 37·70	51 38·26	0·56
3	Sydney	6 52 30·05	6 52 30·71	0·66

Observations.

By Captain Bayfield, R.N. at his house, Charlotte Town, Prince Edward Island.

Occultations.

			Charlotte Town M.T. h m s	Longitude. h m s
1846 May 8	Spica	Imm.	9 31 43·72	4 12 32·03 W
		Em.	10 42 47·22	28·63
1847 Feb. 18	86 Piscium ζ	Imm.	6 4 26·5	28·14
	B.A.C. 369	Imm.	6 5 14·5	31·68
April 20	51 Gemin.	Imm.	10 53 55·0	4 12 36·83

		° ′ ″
West longitude of Captain Bayfield's house	4 12 31·46 =	63 7 52
Observatory Bastion, Quebec, West of Charlotte Town...............		8 5 26
West longitude of Observatory Bastion, Quebec......		71 13 18

"The time was well ascertained by equal altitudes before and after the observations, and carried on by ten chronometers. The emersion of *Spica* being at the bright limb, is probably two or three seconds late.

"The corrections of the moon's place have been furnished by the Astronomer Royal, and applied in the computations."

The following eclipses of *Jupiter's* first satellite have also been observed by Captain Bayfield at the same place.

Immersions.

			Charlotte Town M.T.	Longitude.	
			h m s	h m s	
1846	Oct.	8	9 7 27·20	4 12 23·10	W
		31	9 16 54·79	23·71	
	Nov.	7	11 10 32·42	40·78	
1847	Oct.	27	10 44 12·47	4 12 36·63	
			Mean ...	4 12 31·05	

Emersions.

			Charlotte Town M.T.	Longitude.	
			h m s	h m s	
1843	August	27	9 47 46·11	4 12 24·19	W
1844	Jan.	14	5 50 23·13	21·67	
1846	Feb.	4	10 56 36·30	27·00	
1847	March	4	9 0 14·72	28·08	
		20	7 20 55·52	24·08	
1848	Jan.	22	6 10 38·72	4 12 23·18	
			Mean	4 12 24·70	by Em.
				31·05	by Imm.

West longitude of Charlotte Town ...... =	4 12 27·88	= 63° 6′ 58″
Observatory Bastion, Quebec, West of Charlotte Town	....	8 5 26
West longitude of Observatory Bastion, Quebec	....	= 71 12 24

"The above eclipses were observed under favourable circumstances, with the same telescope and by the same observer."

Observations to determine the Latitude of Dera and the disturbing force of the Himalayas. By Captain Shortrede.

The latitude observations were made at Dera in 1841 with a 12-inch vertical circle of an altitude and azimuth circle, by Troughton and Simms, read by microscopes, and having a telescope 20 inches' focus, with 1·8 inch aperture.

Several altitudes of the stars were observed on each face, and near the meridian, to which they were reduced. The error and rate of the chronometer were found by transits of stars on opposite sides of the zenith.

The accordance of the observations, which are sufficiently numerous, is very satisfactory. The mean of the northern stars gives the latitude 30° 19′ 19″·93 N. of the southern stars 23″·81,

and the mean of both 21″·87. By combining, in pairs, the north and south stars which have nearly the same zenith distance, Capt. Shortrede finds the latitude 30° 19′ 22″·8 N., which result he conceives cannot well be 1″ from the truth.

The place of Captain Shortrede's observations is about 100 feet due west from the chimney of the Surveyor-general's office at Dera. This chimney is fixed by triangulation from the great Indian arc, in the series which passes northward from Kalianpur through Kaliana to Banog. From Banog to the snowy peaks of the Himalayas is about 50 miles.

		° ′ ″	
The latitude of Kalianpur	=	24 07 11·84	N. by observation.
,, Kaliana	=	29 30 48·90	N. ,,
Difference	=	5 23 37·06	
But this difference is by triangulation	=	5 23 43·49	
Or the two results disagree by		6·43	in 323′·6

This arc adjusted by Colonel Everest, in calculating his latitudes from survey, by shortening the distances about 2 feet on 1′ of latitude (see his measure of the Indian arc, p. clxx), and he uses the same allowance in calculating the latitude of Banog from the triangulation.

Captain Shortrede proceeds thus to establish the amount of local disturbance in the latitude of Dera,—

		° ′ ″	
Banog is		0 57 42·18	north of Kaliana, by *survey*.
Dera is		0 8 37·53	south of Banog, ,,
Or Dera is		0 49 4·65	north of Kaliana, by *survey*.
Latitude of Kaliana		29 30 48·89	by *observation*.
Latitude of Dera	=	30 19 53·54	derived from Kaliana and survey.
	=	22·78	by Capt. S.'s observations.
Difference		30·76	

Which seems to arise from the difference of the attraction of the Himalayas at Kaliana and Dera.

By comparing the differences between the azimuths, as observed and calculated from Kaliana to Banog, Capt. S. finds the deflection in azimuth at Banog to be about 15″·16, but not very certain, *i.e.* it may be in error ± 1″.

Captain Shortrede now assumes that the disturbing effect of the Himalayas may be compared to that of a fixed centre of attraction, and proceeds to find the direction and distance of a centre of attraction which would alter the latitude and azimuths in the same way, and to the same amount, that they are found to be altered. He finds a fixed position for a centre of attraction on the above hypothesis, which will change the latitude 30″·76 between Kaliana and Dera, and also change the azimuth 15″·16 between Kaliana and Banog.

"The assumption of a fixed centre of attraction is not faultless, but as matters stand it may serve as an approximation not likely to be greatly erroneous, for on any of the above suppositions the extreme difference in the values of its direction is under 8°, and

for so small a variation in aspect, the error in the assumed fixity is not likely to be great."

To find the Error and Rate of a Chronometer from the observed Transits of Three Stars near the Meridian. By Capt. Shortrede.

This is not a problem of frequent occurrence, but it did present itself to Capt. Shortrede on the first day of his observations at Dera.

His solution is to the following effect: — The transit is supposed to be adjusted for level and collimation, or, which is the same thing, the observations are corrected for these errors. Each observation, when compared with the apparent R.A. of the star, furnishes an equation with three unknown quantities, viz. the *clock error* at the first observation, the *azimuthal error* with a known coefficient (the latitude being known approximately), and the *rate*, which has for a co-efficient the time from the first observation. From these equations the azimuthal error and clock error may easily be deduced if the stars be properly selected; and the rate will be found, unless the stars observed are too near the pole, or follow each other too closely. It would generally be more advisable to get the *rate* from one or more pairs of known stars near the equinoctial, the first of each pair being observed at the beginning and the last at the end of the night's work.

Captain Shortrede wishes it to be remarked "that the limitation in M.N. p. 160, with respect to the polar distance of the star, is unnecessary when the elongations are observed on both sides of the meridian. Errors in the assumed latitude or polar distance of the star will, in this case, correct each other."

Extract of a Letter from Dr. Lee to the Secretary.

"I take leave to offer to the Society for its acceptance an original painting of Mr. Joseph Middleton, who founded, in 1717, the respectable and useful Society of Mathematicians in Spitalfields; the worthy surviving members of which, by the recent act of union, are now Fellows of the Royal Astronomical Society.

"Little is known concerning the life and adventures of this worthy man. It is conjectured that he was the mate or captain of a vessel in the merchant service, and that in the later portion of his life he gave instructions in mathematics, and particularly in those branches which relate to navigation, in the neighbourhood of Spitalfields.

"In the Library of the late Mathematical Society is a manuscript in folio, relating to arithmetic, algebra, and navigation, which is supposed to have belonged to and to have been composed

by him: from the contents of this volume he probably gave his lectures. It is believed that he died between 1725 and 1730.

"Since this portrait came into my possession it has been repaired by Mr. Edwin Holder, a skilful artist, from a copy which was made at the request of the Mathematical Society by Mr. Saubergue, about the year 1835.

"The copy is in my possession, and it agrees in its general character with the original, and differs in some of the minor details.

"I am informed by Mr. Williams that Mr. Saubergue was an artist of much merit, and that he died at the age of twenty-four."

"Mr. T. B. Honegger, architect, has discovered, at HAMAM EL BAS, 72 geographical miles from Tunis, a fragment of a Punic monument upon which a constellation * is represented by round holes of equal size over three figures in relief. The middle figure is a female, barefooted, with naked arms, and wrapped up in a long garment; a tower-crown is upon her head, to which the royal cloak is fastened, which hangs over her shoulders and knees. In her right hand she holds a large artichoke, and in the left a double cornucopia, with the hasta which rests on the head of a ram at her feet. On her right hand stands Mars, and on her left Mercury.

"From the time of planting the artichoke and shearing sheep in that country (to which it is conjectured that the abovementioned symbols refer), it may be thought probable that the figure represents the goddess Athir and the month April."

Mr. Hind says,—"Since June 30 the *new star* has appeared of the 7·8 mag., and is therefore very slowly diminishing. Its colour is still very red."

Mr. Woolgar remarks,—"There is a considerable difference in the estimated magnitude of another star in the same neighbourhood:—

✱ = Bode 152 *Oph.* 6 mag., *his own observation.*
= H.C. 31341 8 —
= Weisse xvii. 110 7·8 —

M. Rümker remarks, "that there is a star of the ninth magnitude twice observed by Lalande, and also by Bessel, of which the apparent place is, according to Bessel,

1848, July 2. R.A. $22^{h}\,21^{m}\,2^{s}\cdot 65$. N.P.D. $100^{\circ}\,42'\,23''\cdot 3$.

"Now close to this star I find another star of the seventh magnitude, mentioned neither by Lalande nor Bessel, the apparent place of which is

1848, July 2. R.A. $22^{h}\,21^{m}\,2^{s}\cdot 51$. N.P.D. $100^{\circ}\,42'\,19''$.

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* The configuration is given of 7 stars, which somewhat resemble the square in *Pegasus.*

"It is scarcely reasonable to suppose that both Lalande and Bessel made such a mistake in the magnitude of the star, as to set it down as of the ninth while omitting the companion. It has no motion, so is probably a changing star."

Errata communicated by Mr. Woolgar.

P. 156, *for* Weisse's Bessel xvi. 956 *read* xvi. 962.
157, line 1, — Piazzi xvii. 191, — xvi. 191, 20 *Ophiuchi.*

The star "of about 6 magnitude," mentioned just afterwards, is H.C. 31188 = Bode 133 *Ophiuchi*, 5 mag.

Errata in the Monthly Notice for May.

Page 147, line 4, *for* "St. Vidart," *read* "St. Vidast."
161, 13 from the bottom, *for* "1542," *read* "1548."

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Dr. Pearson's Practical Astronomy.

The late Dr. Pearson bequeathed to the Society the stock of his *Introduction to Practical Astronomy* remaining unsold at his death. There are about 100 copies of the entire work, and 400 copies of the first volume, which contains the tables.

The Council have resolved to sell these at the following prices to fellows and associates of the Society:—

	£	s.	d.
The whole work, 2 vols. text, and 1 of plates	1	1	0
The 1st vol., containing all the tables	0	5	0

The price to non-members is double.

Copies are now ready, and it is desirable that they should be applied for soon. So many are already disposed of that it would not be prudent to risk any further delay.

Discovery of a new Satellite of Saturn.[*] By W. Lassell, Esq.

"In communicating to you the particulars attending the discovery of an eighth satellite of *Saturn*, I shall adopt the proper names proposed by Sir John Herschel for the seven hitherto known satellites, namely, *Mimas*, *Enceladus*, *Tethys*, *Dione*, *Rhea*, *Titan*, and *Japetus*, beginning with the closest, and proceeding in order of distance from their primary. The new satellite I have proposed, in conformity with this nomenclature, to call *Hyperion.*

"On the 18th September, while surveying the planet in the twenty-foot equatoreal, and looking out for *Japetus*, (which I expected to find following the planet and not far from the plane of his ring,) I remarked *two* stars exactly in the line of the interior satellites. Not being certain at the time which of these was *Japetus* (although the nearer of the two certainly seemed too faint), I made a careful diagram of their positions with respect to *Saturn*, and also to some neighbouring fixed stars.

"The next night, the 19th, proved fine, and I was astonished to find that the *two* stars had both moved away from the fixed stars to which they had been referred, and were still accompanying *Saturn;* the more distant of the two had also gone northward, in conformity with the orbital motion of *Japetus*, while the nearer and

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[*] The new satellite was, it is said, discovered at the Observatory of Cambridge, U.S., on Sept. 16th, but no account has been received from Professor Bond.

fainter, remaining precisely in the line of the inferior satellites, appeared to have slightly approached the planet.

"A consideration of this appearance suggested the idea that the more distant was *Japetus*, and that the nearer and fainter must be a new satellite of *Saturn*. To verify the suspicion, I took differences of right ascension between each and a fixed star, and found that in $2^h\ 36^m$ the suspected satellite had moved westward $2^s{\cdot}46$, and that in $1^h\ 24^m$ *Japetus* (the identification of which was now certain) had also moved westward $1^s{\cdot}27$. It is true that these differences are somewhat greater than is consistent with the orbital motion of *Saturn*, yet perhaps not greater than is consistent with reasonable errors of observation during so short a period. Moreover, as the suspected new satellite was situated precisely in the line of the satellites interior to itself, I took micrometrical measurements of its situation at two epochs, four hours apart, and was satisfied that during that interval no perceptible change whatever took place in its position in the line of the satellites. As the motion of *Saturn* southwards in the same period amounted to 18″, he must have left the suspected satellite obviously behind if it had been a fixed star. I could, therefore, now arrive at no other conclusion than that I had discovered a satellite hitherto undetected.

" I regret that since the 19th September the weather has been remarkably unfavourable. I obtained a good set of measures of the elongation of the satellite on the 21st, and two very hasty measures on the 22d, caught between clouds, which, with an *estimation* of its elongation on the 18th, are all the data I have hitherto obtained towards the determination of its period. Since the latter date the weather has been uniformly cloudy.

" If these observations should be thought worthy of being recorded until better can be obtained, they would stand thus:—

Sept. 18, Elongation east of *Saturn* (estimated by comparison with *Titan*)	4′ 20″
21, Elongation, measured	3 54
22, Ditto ditto	3 27

" These observations would, I believe, be best satisfied by a period of about 24 days, which may at least serve as a guide in looking for the satellite. Its magnitude is very small,—perhaps not intrinsically so great as that of *Mimas*,—though it was much easier to see, on account of its greater distance from the planet.

" During this autumn I have twice been gratified with a sight of the whole seven satellites of *Saturn* at one time, viz. on the 19th August and on the 16th September, at $11^h\ 15^m$. The observations of the latter evening were very interesting. I first saw the planet a little before 10^h, when *Tethys* was behind the planet, and *Enceladus* and *Dione* absolutely in one. I immediately recognised *Mimas*, and in a very short time *Enceladus* emerged from conjunction with *Dione*, and then appeared with the latter as the most delicate double-star possible. At $11^h\ 30^m$ *Titan* had approached close up to the ball, and was apparently in contact with it. At

11^{h} 35^{m} it had become occulted. At 11^{h} 5^{m} I observed *Tethys* just emerging from behind the ball, and noticed that he emerged evidently *south* of the line joining the other satellites. As the present position of the ring requires that, if revolving in its plane, the satellite should appear rather to the *north* on its emergence, this fact seems to afford some evidence that the satellite does not revolve precisely in the plane of the ring. Moreover, at 11^{h} 50^{m}, when *Tethys* and *Mimas* formed an exquisitely delicate double-star, *Tethys* was still south of *Mimas*, although, as *Tethys* was receding from the planet and *Mimas* approaching it, the reverse ought to have been the case if the former really revolves in the plane of the ring.

"At 10^{h} 5^{m} this evening (Sept. 16) *Mimas* was, as nearly as could be estimated, at his greatest elongation eastward; and on the 16th October, 1847, at 8^{h} 35^{m}, I observed him at or very near his greatest elongation westward. The interval elapsing amounts to 336·045 days; and supposing him to have made in that time 356·5 revolutions, 22^{h} 37^{m} $22^{s}{\cdot}6$ will be the period of one revolution."

Extract of a Letter from Mr. Lassell.

"I am happy to tell you that I have at length brought my polishing machine to do all that I ever hoped or purposed it should do. I had previously obtained very good surfaces with it, but they were obtained with some anxiety and uncertainty. I wished to be able to repolish a known good surface without hurting it, as well as to turn a bad one into a good one with certainty and expedition. This, I am happy to say, I can now do; and by certain rules, varying with the proportion of the focal length to the aperture, I can produce a parabolic surface which shall have the same focus in every part of its surface to the hundredth of an inch. The improvement in regularity of curve is not less than in the truth of its general form. I am about to make some experiments on the further shortening of focus, viz. a 12-inch metal of 7-feet focus, more, however, as a curiosity than for utility."*

FLORA.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1848.	Greenwich M.T.	R.A.	Obs^d—Cal^d	N.P.D.	Obs^d—Cal^d	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s	s	° ′ ″	″			
May 1	8 54 40·7	6 42 47·63	−0·20	65 46 2·1	−15·0	7	7	*a*
2	9 1 39·2	44 49·66	−0·66	46 45·7	17·6	6	6	*b*
3	8 43 47·9	46 49·96	−0·92	47 39·6	15·6	10	6	*b*
4	9 18 52·5	48 55·24	−0·85	48 43·3	13·2	6	6	*b*
5	8 56 24·2	50 56·15	−0·45	49 39·3	23·0	3	2	*c*
	9 11 29·2	57·83	−0·06	40·6	22·5	5	5	*d*
6	9 16 48·6	6 53 0·99	+0·11	65 51 5·0	−11·2	7	7	*e*

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* Mr. Lassell is preparing an account of his polishing machine and methods of grinding specula, &c. to be laid before the Society.

1848.	Greenwich M.T. h m s	R.A. h m s	Obsd—Cald s	N.P.D. ° ′ ″	Obsd—Cald ″	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
May 8	10 6 57·5	6 57 10·18	−0·46	65 53 52·6	−12·2	1	1	*f*
	10 12 8·2	10·39	−0·69	50·7	14·4	4	4	*g*
9	9 31 53·1	6 59 10·31	−0·25	55 19·1	16·8	7	7	*h*
10	9 21 2·4	7 1 12·75	+0·11	57 7·6	7·4	6	6	*i*
11	9 7 5·7	3 14·84	+0·28	65 58 48·1	12·4	7	7	*j*
12	9 43 41·3	5 20·95	+0·09	66 0 49·1	7·6	5	5	*i*
13	9 47 57·3	7 23·96	−0·53	2 49·3	8·0	6	6	*k*
16	9 59 0·7	13 35·31	−0·26	9 24·7	14·4	6	6	*l*
17	9 39 8·6	15 36·58	−0·76	11 44·6	19·2	7	6	*l*
22	9 30 13·6	25 53·52	−0·79	25 45·3	7·0	6	5	*m*
23	9 28 55·8	27 57·47	−0·31	28 48·4	11·9	6	6	*m*
27	9 41 48·1	7 36 13·78	+0·62	66 42 25·3	− 4·6	4	4	*n*

"The comparisons are made with Mr. Hind's Ephemeris, *Monthly Notices*, vol. viii. No. 3.

"The observed places are corrected for refraction and parallax, and in the comparison with the calculated places aberration is taken into account.

"The following are the authorities for the adopted mean R.A. and N.P.D. of the stars:—

a = H.C. 13279
b = — 13313
c = — 13497
e = B.Z. 348: 6h 51m 45s
f = B.A.C. 2299
h = H.C. 13804
i = B.A.C. 2350
j = H.C. 13856
k = H.C. 14030
l = B.A.C. 2434
m = H.C. 14722
n = — 15112

"The adopted apparent places of the remaining two stars, which were determined by equatoreal comparisons, are the following:—

Star.	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″	By comparison with
d	6 48 0·24	65 52 10·8	B.A.C. 2299
g	6 55 56·89	66 3 5·8	— —

"In the comparison of the Cambridge Equatoreal Observations of *Flora* in the *Monthly Notice*, No. 8, with Mr. Hind's Ephemeris, the correction for aberration was inadvertently applied with the wrong sign. When this mistake is corrected, the excesses of the observed above the calculated N.P.D. will stand as follows:—

	″		″		″		″
Feb. 16	− 8·2	March 3	− 8·6	March 28	−12·4	April 19	−16·0
	− 2·1	10	−11·9	29	+ 0·2		−15·2
	− 1·9	14	−18·2	April 1	− 6·1	28	− 9·2
17	+ 1·2	18	−21·0	6	− 8·7		−13·2
	−12·0	20	−14·2	10	+ 1·7	29	−10·0
18	−10·7		−17·9	14	−13·8		−12·6
27	− 7·6	21	− 8·2	17	−11·1		
28	− 3·8		−21·7		−10·4		

MAKERSTOUN. Equatoreal. (Sir T. Brisbane and Mr. J. Welsh.)

Date. 1848.		Greenwich Mean Time.	R.A.	N.P.D.	Ephem. — Obs. R.A.	Ephem. — Obs. N.P.D.	No. of Comps.	Star of Comparison.
		h m s	h m s	° ′ ″	s	″		
Feb.	10	8 21 0	4 26 37·60	70 14 44·6	+0·68	−0·9	13	Taylor, 1598
		8 22 17	37·73	46·3	0·60	−2·9	8	B.A.C. 1417
	11	7 42 17	27 38·50	70 8 47·3	0·58	−0·3	12	Taylor, 1598
	17	9 22 43	34 29·21	69 32 23·5	0·75	−5·2	9	*a*
	25	8 7 13	44 41·64	68 46 47·4	0·95	−0·3	1	B.A.C. 1551
		8 12 34	42·09	45·8	0·81	+0·1	2	*b*
	26	7 5 40	4 46 0·86	68 41 29·5	0·71	1·4	10	*b*
		7 17 9	1·67	27·7	0·56	0·6	1	B.A.C. 1551
Mar.	13	9 26 1	5 10 32·82	...	(1·06)	...	9	*c*
		9 34 42	...	67 21 42·9	...	(2·9)	5	*c*
	21	8 28 39	24 5·32	66 49 46·7	0·77	3·4	4	B.A.C. 1774
		8 34 26	5·68	46·3	0·83	2·9	9	*d*
	24	7 54 26	29 20·54	39 16·2	0·74	4·9	10	B.A.C. 1774
	28	8 55 1	...	26 27·7		0·5	4	*e*
		9 2 37	36 38·06	...	0·89	...	12	*e*
	29	7 56 23	38 22·72	23 34·6	0·83	4·3	8	*e*
	31	8 46 5	...	17 54·4	...	3·5	4	*f*
		9 0 1	42 8·48	...	0·95	...	7	*f*
April	1	8 17 40	43 57·03	...	0·84	...	11	*g*
		8 28 34	...	15 18·5	...	3·0	4	*g*
		8 35 57	...	17·7	..	3·0	4	*h*
		8 44 44	58·98	...	0·61	...	8	*h*
	3	8 11 12	47 40·45	10 22·8	0·81	2·1	5	*i*
	5	8 25 38	51 27·59	...	1·01	...	15	*k*
		8 27 4	...	66 5 44·0	...	5·8	5	*k*
	8	9 7 34	5 57 13·78	65 59 38·3	1·19	5·7	1	*l*
	10	9 1 53	...	56 7·8	...	7·1	5	*m*
		9 7 52	6 1 4·94	...	0·89	...	12	*m*
	11	8 48 25	2 59·29	...	1·00	...	9	*m*
		8 55 0	...	54 33·0	...	7·3	5	*m*
	14	8 26 35	...	50 26·0	...	9·8	4	B.A.C. 2011
		8 43 23	8 49·35	...	0·92	...	9	— —
	17	8 47 4	...	47 17·4	...	10·9	1	— —
		9 0 2	...	18·0	...	9·8	2	*n*
		9 8 17	14 45·21	...	0·61	...	3	*n*
		9 13 1	45·59	...	0·92	...	2	B.A.C. 2011
	29	9 20 17	...	65 44 58·9	...	+7·4	7	*o*
		9 25 45	6 38 46·77	...	+0·38	...	20	*o*
May	8	10 5 7	6 57 9·45	...	...	...	9	*p*
		10 27 0	...	54 1·8	...	...	2	*p*
	10	10 11 38	...	65 57 7·4	...	...	4	*p*
		10 18 26	7 1 16·75	...	...	...	7	*p*

"The observations have been corrected for refraction and parallax. The corrections for aberration have been applied to Mr. Hind's Ephemeris (*Monthly Notices*, January 14), and the observed places compared with it.

"N.B. The observations of *Flora* at Makerstoun, printed in the *Monthly Notice* for March last, were not corrected for aberration previously to being compared with the Ephemeris.

"The mean places of the following stars have been obtained by comparison with known stars; when two or more comparisons have been obtained, they may be considered as tolerably correct. The place of the star *c* has been roughly *assumed* from the comparison with the planet.

Star.		Mag.	Mean R.A. 1848·0. h m s	Mean N.P.D. 1848·0. ° ′ ″	No. of Comps.	Star of Comparison.
a	H.C. 8844	7½	4 34 7·51	69 39 57·7	1	B.A.C. 1570
b	H.C. 9228,9		4 47 10·72	68 40 29·9	2	— 1551
c		8½	5 8 22·00::	67 20 35·0::		approximate.
d		8	5 24 20·00	66 46 19·1	3	B.A.C. 1774
e	H.C. 10844	8	5 36 42·62	66 19 17·0	5	— 1951
f		8	5 39 22·53	66 16 27·0	3	— 1951
g		9	5 43 46·65	66 18 58·7	3	— 1951
h		9	5 43 52·41	66 20 53·5	5	*g*
i		8½	5 46 43·04	66 9 26·7	1	B.A.C. 1951
k		8	5 52 52·02	66 4 44·0	3	— 2011
l	H.C. 11592	7½	5 58 54·02	66 7 32·2	1	— 2011
m	H.C. 11796	8	6 4 51·37	65 58 38·6	4	— 2011
n		8½	6 13 58·37	65 48 3·8	2	— 2011
o		8	6 38 41·83	65 41 22·6	3	— 2299
p		8	6 57 59·78:	65 52 13·3:	1	— 2299

All the observations were made by Mr. John Welsh.

"The star *m* has been observed by Taylor (No. 2360 of *Madras General Catalogue*); his R.A. reduced by precession alone to 1848·0 is $6^{h}\ 4^{m}\ 51^{s}{\cdot}80$, and, allowing the proper motion assigned by him, $6^{h}\ 4^{m}\ 52^{s}{\cdot}07$. There is another star about 2′ south of this, viz. Taylor, 2361 = Piazzi, vi. 14; two comparisons with B.A.C. 2011 give its R.A. for 1848·0, $6^{h}\ 4^{m}\ 51^{s}{\cdot}65$. Taylor's is $6^{h}\ 4^{m}\ 53^{s}{\cdot}22$; and allowing his proper motion, it is $6^{h}\ 4^{m}\ 53^{s}{\cdot}84$. If Taylor's R.A. is accurate, there seems to be something peculiar about the proper motions of these two stars. The place of the star *m*, both in R.A. and N.P.D., deduced from comparison with B.A.C. 2011, has been used (in the mean time) in preference to Taylor's; the N.P.D. agrees pretty well with Taylor."*

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* The two stars mentioned by Mr. Welsh are H.C. 11796, 11797 = Piazzi, vi. 13, 14. The differences of right ascension between the two stars, according to these authorities, agree with that found by Mr. Welsh, so that there is no probability of any *relative* proper motion. There is an error of $+1^{s}$ in the right ascension of Taylor 2361. The star *m* must be reobserved to decide with respect to its correct right ascension.

NEPTUNE.

CAMBRIDGE. Meridian. (Professor Challis.)

1848.	Greenwich M.T. h m s	R.A. h m s	Obs^{d}—Calc^{d}. s	N.P.D. ° ′ ″	Obs^{d}—Cal^{d}. ″
July 17	14 32 55	22 17 26·16	−1·04	101 20 2·5	+5·8
18	14 28 55	17 21·61	0·92	20 30·8	6·2
26	13 56 48	16 41·49	1·00	24 25·7	3·8
Aug. 1	32 40	16 8·89	0·81	27 39·9	4·7
2	28 38	16 2·99	1·05	28 14·3	5·9
5	16 33	15 45·72	1·05	29 54·0	4·9
7	8 29	15 33·97	1·07	31 2·0	4·5
9	13 0 26	15 22·12	1·04	32 10·4	3·9
10	12 56 24	15 15·99	1·17	32 48·3	7·1
17	28 10	14 33·42	1·02	36 51·2	3·5
19	20 6	14 20·84	1·21	38 1·5	2·7
21	12 1	14 8·21	1·40	39 15·5	5·5
22	7 59	14 2·14	1·25	39 51·3	5·6
23	12 3 57	13 55·85	1·29	40 26·2	4·9
24	11 59 55	13 49·60	1·31	41 2·6	5·7
29	39 44	13 18·38	1·37	43 59·0	4·7
Sept. 1	27 38	12 59·85	1·34	45 44·7	5·2
2	23 36	12 53·74	1·30	46 20·0	5·7
4	15 32	12 41·51	1·30	47 30·7	7·4
6	7 28	12 29·32	1·36	48 37·2	5·4
7	11 3 26	22 12 23·27	−1·40	101 49 11·6	+6·0

The N.P.D. have been corrected by −0″·27 for parallax.

DURHAM. Equatoreal. (Prof. Chevallier & Rev. R. A. Thompson.)

1848.	Greenwich M.T. h m s	R.A. h m s	Obs^{n}—Eph^{s}. s	N.P.D. ° ′ ″	Obs^{n}—Eph^{s}. ″	No. of Obs.	
Aug. 28	12 4 48·4	22 13 24·47	−1·40	101 43 22·3	+2·8	6	B.A.C. 7821
29	11 30 17·1	13 18·48	1·31	43 58·2	4·1	6	— —
31	11 55 40·7	13 6·00	1·25	45 11·5	6·3	7	— —
Sept. 1	12 11 33·0	12 59·59	1·41	45 42·6	2·0	3	— —
6	9 51 13·8	12 29·59	1·41	48 34·6	4·6	2	— —
8	11 36 44·1			49 43·2	3·2	2	— —
12	10 1 22·2	11 53·67	1·65	51 57·2	6·9	7	— —
	12 8 40·8	53·15	1·65	58·9	5·7	6	B.A.C. 7740
14	10 24 48·7	11 41·89	1·78	53 0·3	4·9	1	— —
	10 41 54·0	42·05	1·59	2·7	6·9	Meridian, faint	
16	10 33 51·9	22 11 30·68	−1·61	101 54 7·0	+8·1	Meridian, faint	

Corrections have been applied for parallax, and the results are compared with Mr. Adams' Ephemeris.

Mean Places of Stars, June 1, 1848, from Meridian Observations, Durham.

	R.A. h m s	No. of Obs.	N.P.D. ° ′ ″	No. of Obs.
B.A.C. 7740	22 4 20·26	2	101 48 46·8	1
B.A.C. 7821	22 18 36·85	2	101 59 54·5	2

Nearly agreeing with B.A.C. in north polar distance. The right ascensions of the catalogue seem to be about $0^s.5$ too large.

Elements.

Mr. Sears C. Walker gives the following elements of *Neptune* as the latest results of his investigations:—

$$\left.\begin{array}{l} \varpi = 47^\circ\,12'\,6''.50 \\ \Omega = 130\ \ 4\ \ 20.81 \end{array}\right\}\ \text{M. Eq. Jan. 1, 1847}$$

$i = 1\ \ 46\ \ 58.97$

$e = 0.00871946$

$\mu = 21''.55448$

$M = 328^\circ 32' 44''.20$ Greenh M. Noon, Jan. 1, 1847

$T = 164.6181$ Tropical Years.

Professor Peirce has computed the perturbations of *Uranus* by *Neptune*, taking an approximate value of his elements and using the mass which is given by Lassell's Satellite. He has stated the results of a comparison between the observed and calculated places of *Uranus*, from 1690 downwards, using these perturbations, and finds them satisfactory throughout.

"It will be perceived," he says, "from this table, that the motions of *Uranus* contain no indications of another external planet, or of any error in the mass of *Saturn*. *Neptune* stands, therefore, in direct opposition to the proposition that no planet placed at a less mean distance than 35 times the distance of the earth from the sun, can possibly account for the observed irregularities in the motion of *Uranus* to within 5″ of arc for modern observations and 10″ for ancient ones.* The table is computed from Walker's last elements of *Neptune* as a basis."

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* This alludes to the limit 35·04 which M. Le Verrier assigned as the lowest value of the mean distance of the planet exterior to *Uranus*. There has been a good deal of discussion of late upon this point, which may be found in the recent numbers of the *Comptes Rendus* and in the *Athenæum* journal. Professor Peirce has given in his table the elements of the exterior planet as found by Mr. Adams on two hypotheses of mean distance, and he seems to have concluded that these contained the *final results* obtained by Mr. Adams. This is not the case, and it is worth while to refer particularly to Mr. Adams' letter of Sept. 2, 1846 (*Monthly Notices*, vol. vii. p. 137). Having obtained elements of the disturbing planet on two hypotheses of mean distance, Mr. Adams examines how far the observations of *Uranus* correspond to the two hypotheses, and concludes, that from 1712 almost to 1840 the observations are equally well represented on either hypothesis, but that, towards the end of that time, and later, the errors begin to increase, until, in 1843, they are very sensible; being, moreover, always larger in the hypothesis of the larger mean distance. He infers (p. 139), "that the agreement between theory and observation would be rendered very close by assuming the ratio of the mean distances of *Uranus* and its disturbing planet to be as 0·57

HEBE.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1848.	Greenwich M.T. h m s	Apparent R.A. h m s	Log. $\frac{p}{P}$	Apparent N.P.D. ° ′ ″	Log. $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
Aug. 22	14 9 22·2	5 12 45·17	−8·600	81 26 5·8	−9·877	1	1	*a*
	14 31 10·0	47·39	8·583	8·9	9·872	10	6	*b*
	15 18 0·7	50·62	8·542	5·1	9·862	2	2	*c*
24	13 31 51·4	16 18·79	8·614	81 30 9·9	9·885	7	6	*d*
Sept. 4	14 57 54·7	35 13·77	8·529	82 0 27·3	9·863	8	6	*e*
6	14 5 14·9	5 38 23·74	8·580	82 7 6·4	9·873	4	4	*e*
	14 17 16·1	25·15	−8·569	8·6	−9·871	2	2	*f*

No correction has been applied for parallax. (See note to *Metis.*) The following are the adopted mean places of the stars.

	Mean R.A. 1848·0 h m s	Mean N.P.D. 1848·0 ° ′ ″	Star.
a =	5 12 32·14	81 27 59·6	B.A.C. 1656
b =	5 13 27·09	81 43 35·2	Not in catalogues
c =	5 9 52·05	80 57 2·0	Bessel, v. 219
d =	5 16 24·09	81 38 29·8	— v. 375
e =	5 35 26·37	82 5 55·9	H.C. 10816
f =	5 39 40·35	82 5 56·6	Bessel, v. 1015

to 1·0:" *i. e.* the semi-axis major of the exterior planet to be 33·6 nearly. As a consequence of this change in the semi-axis major he also infers, "that the excentricity of the exterior planet would be very small," and it is evident that the mass would also be much diminished. In these respects Mr. Adams' theoretical elements make a notable approach to the elements of *Neptune*. He infers, too, "that the corresponding mean longitude, 1st October, 1846, would be about 315° 20′," which is wide of the truth, for as his mean distance assigns no sensible value to the excentricity, his mean and true heliocentric longitudes cannot differ widely, whence the error in the assigned place of the planet would be nearly 10° (See Mr. Adams' remarks, *Nautical Almanac*, 1851, Appendix, p. 291).

On looking over Mr. Adams' solution, we find that his first determination is of the *difference of mean longitude between Uranus and his disturbing planet in* 1810·328. On his first hypothesis of $\frac{a}{a'} = 0·5$ he finds the longitude of the disturbing planet = 269° 25′, on his second hypothesis of $\frac{a}{a'} = 0·515$ he finds the longitude of the disturbing planet = 264° 50′, whence it would follow (if simple proportion can be trusted in such a case) that for $\frac{a}{a'} = 0·57$ the resulting mean longitude = 248° 1′ nearly, *i.e.* at 1810·328. Now this was, very nearly, the longitude of *Neptune* at that time, the error in 1846 being almost wholly due to the erroneous mean motion in bringing up the mean longitude to 1846.

It will be seen, on carefully considering the tables in *Nautical Almanac*, 1851, Appendix, pp. 289, 290, that the observations from 1712 to 1840 can be equally well satisfied on different hypotheses of the mean distance of the disturbing planet, and that, from the nature of the case, the changes in the perturbations resulting from a difference in the assumed mean distance are compensated by corresponding changes in the elements of *Uranus* and the disturbing planet. Within what limits this general statement is true must be left to competent inquirers.

These places were derived from the Catalogues, with the exception of those of *a* and *b*, which were determined by equatoreal comparisons with 14 *Orionis*, the place of the former star being given only approximately in the British Association Catalogue.

HAMBURG. Equatoreal. (M. Rümker.)

1848.	Hamburg M.T.	R.A.	Dec.
	h m s	° ′ ″	° ′ ″
Sept. 4	14 28 9·4	83 47 22·9	+7 59 51·4
5	14 36 55·9	84 11 19·4	56 29·9
6	13 58 33·7	35 20·7	52 55·3
7	14 23 11·7	84 59 25·5	49 26·2
9	13 58 53·3	85 46 6·6	42 5·8
12	14 35 57·4	86 55 8·0	30 11·6
14	13 8 23·0	87 38 0·5	22 31·1
15	15 46 48·8	88 0 47·0	7 17 34·1::
20	13 29 28·8	89 44 35·2	6 56 12·0
21	13 12 58·0	90 4 9·5	51 51·1
22	13 26 41·3	90 24 2·0	47 3·4
23	12 55 57·6	91 42 54·5	42 13·4
24	12 55 40·4	91 1 51·8	+6 37 51·9

IRIS.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1848.	Green. M.T.	Appt R.A.	Log. $\frac{p}{P}$	Appt N.P.D.	Log. $\frac{q}{P}$	No. of Comps.	Star.
	h m s	h m s		° ′ ″			
Aug. 22	15 42 23·4	7 35 26·11	−8·641	69 21 57·1	−9·859	3	*a*
Sept. 2	15 3 50·9	7 59 22·51	8·637	70 43 1·5	9·874	4	*b*
6	14 52 9·0	8 7 45·71	8·635	71 15 8·9	9·877	3	*c*
	15 19 20·5	48·41	−8·635	17·3	−9·863	4	*d*

Parallax has not been applied. The stars and authorities for their places are the following,—

a = B.A.C. 2556 *b* = B.A.C. 2683 *c* = B.A.C. 2759 *d* = H.C. 16245

The results of comparison with Mr. Hind's Ephemeris (*Monthly Notice*, No. 8), after correcting for parallax and aberration, are as follows:—

	R.A. Obsd—Cald	N.P.D. Obsd—Cald
	s	″
August 22	− 7·92	−27·5
Sept. 2	8·68	39·2
6	10·15	44·8
	− 9·81	−45·6

HAMBURG. Equatoreal. (M. Rümker.)

1848.	Hamburg M.T.	R.A.	Dec.
	h m s	° ′ ″	° ′ ″
Sept. 23	14 34 54·2	130 22 23·8	+16 15 35·6

SOUTH VILLA. Equatoreal. (MM. Bishop and Hind.)

1848.	Greenwich M.T.	R.A.	Dec.
	h m s	° ′ ″	° ′ ″
August 7	14 50 57	105 11 31·9	+22 8 33·3
22	14 30 26	113 49 48·8	+20 38 24·0

Mr. Hind says, " My ephemeris is in error.

	$\Delta\alpha \cos\delta$	$\Delta\delta$
	′ ″	″
August 7	+1 24·9	−19·3
22	+1 51·2	−21·7

The planet shone as a star of the 11–12th magnitude.

ASTRÆA.

CAMBRIDGE. Meridian. (Professor Challis.)

1848.	Greenwich M.T.	R.A.	No. of Wires.	N.P.D.	Log. $\frac{q}{P}$
	h m s	h m s		° ′ ″	
Aug. 9	12 15 55·3	21 30 44·63	4	104 26 27·8	−9·961
17	11 37 30·9			105 10 51·9	9·964
21	18 27·5	20 25·83	4	32 34·0	9·965
22	13 41·3	19 35·42	3	37 44·8	9·965
23	8 54·9	18 44·79	4	105 42 49·9	−9·966
24	11 4 11·7	21 17 57·36	5		

Northumberland Equatoreal.

1848.	Greenwich M.T.	Apparent R.A.	Log. $\frac{p}{P}$	Apparent N.P.D.	Log. $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s		° ′ ″				
Aug. 9	11 14 8·5	21 30 42·43	−8·049	104 26 27·5	−9·959	2	2	*a*
	11 23 24·0	42·21	−7·982	19·8	9·959	12	11	*b*
17	12 1 1·3	23 46·65	+7·634	105 11 8·6	9·963	6	6	*c*
19	12 51 56·6	22 2·72	8·182	22 10·6	9·959	7	7	*d*
24	12 47 14·2	17 54·36	8·267	105 48 33·1	9·958	5	8	*e*
Sept. 2	10 55 24·3	21 11 11·73	7·763	106 31 13·7	9·967	5	3	*f*
	11 4 47·2	11·42	+7·898	14·2	−9·966	4	4	*g*

Corrections for parallax have not been applied either to these or to the meridian observations. The letters P, *p*, *q*, have the signification explained under the observations of *Metis*.

The following adopted mean R.A. and N.P.D. of the comparison stars were determined by meridian observations, with the exception of the N.P.D. of the star *c*, which was taken from Bessel.

	Mean R.A. 1848·0.	Mean N.P.D. 1848·0.	Designation of Star.
	h m s	° ′ ″	
a	21 33 16·62	104 43 22·0	42 Capricorni
b	21 29 58·20	104 12 49·4	Bessel xxi. 716
c	21 22 20·49	104 57 15·4	— xxi. 522
d	21 20 28·50	105 28 49·9	Not in catalogues
e	21 18 4·24	105 53 57·8	H.C. 41647
f	21 10 47·97	106 48 51·0	B.A.C. 7396
g	21 9 25·30	106 31 21·7	H.C. 41317

HAMBURG. Equatoreal. (M. Rümker.)

1848.	Hamburg M.T.	R.A.	Decl.	No. of Obs.
	m h s	m h s	° ′ ″	
July 27	13 54 57·8	325 19 55·5	−13 15 14·3	5
29	12 20 38·2	324 57 25·4	25 46·7	11
30	11 35 28·1	46 4·1	30 48·3	20
Aug. 1	11 28 20·6	21 56·3	41 38·1	5
2	11 57 55·3	324 9 28·2	47 5·8	13
3	10 53 36·0	323 57 45·9	13 52 21·5	4
6	10 19 29·7	20 19·4	14 9 9·2	6
7	10 46 28·7	323 7 6·3	14 46·1	16
9	12 51 51·9	322 40 7·0	14 26 31·2	6
18	9 12 59·1	320 45 37·4	15 15 53·4::	
19	9 58 54·7	320 32 44·6	21 13·6	6
25	9 24 15·5	319 18 39·2	15 42 45·0	18
28	10 49 10·4	318 43 4·2	16 7 55·0	10
30	9 55 40·3	21 5·8	27 25·2	5
31	9 34 55·6	318 10 6·5	21 48·2	15
Sept. 4	9 15 57·0	317 28 43·0	39 11·3	20
5	9 53 56·5	317 18 50·5	−16 43 35·9	11

METIS.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1848.	Greenwich M.T.	Appt R.A.	Log. $\frac{p}{P}$	Appt N.P.D.	Log. $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s		° ′ ″				
June 7	11 49 31·8	14 20 17·80	+8·418	101 22 41·2	−9·937	6	6	*a*
13	12 7 0·6	18 4·12	8·504	26 46·2	9·929	6	6	*b*
22	10 54 0·3	16 29·67	8·435	101 41 8·8	9·937	6	6	*c*
July 5	10 59 17·1	17 49·83	8·534	102 17 27·7	9·926	1	1	*d*
	11 12 43·6	50·06	8·549	43·2	9·923	7	7	*e*
6	10 9 40·0	18 5·68	8·450	21 3·2	9·936	7	8	*e*
12	9 51 55·2	20 11·96	8·464	43 59·4	9·937	9	8	*f*
13	10 23 34·6	20 38·12	8·522	48 13·5	9·929	12	13	*f*
15	10 7 3·8	21 32·73	8·509	102 56 41·6	9·932	7	7	*f*
27	9 44 30·4	28 22·10	8·537	103 53 57·9	9·929	5	5	*g*
Aug. 4	9 21 36·9	14 34 55·43	8·542	104 36 55·8	9·929	5	5	*h*
	9 30 9·2	56·36	+8·553	54·4	−9·927	1	1	*i*

"P is the equatoreal horizontal parallax, and *p*, *q*, are the corrections for parallax which are yet to be added to the apparent R.A. and N.P.D., the former expressed in seconds of time and the other in seconds of space. Hence the logarithms of *p* and *q* will be obtained by adding to the logarithms given in the above table,

the logarithms of the equatoreal horizontal parallax for the respective times of observation.

The following are the reference-stars, the adopted places of which are taken from the catalogues cited:—

a	Bessel xiv. 424	*d*	Bessel xiv. 278	*g*	Bessel xiv. 512
b	B.A.C. 4772	*e*	— xiv. 280	*h*	— xiv. 596
c	Bessel xiv. 259	*f*	B.A.C. 4787	*i*	— xiv. 701

PETERSEN'S COMET.

On the 7th of August, about 14^h, Dr. Petersen discovered a telescopic comet in *Auriga.* "The comet was small, but pretty well defined, bright and good to observe."

Observations.

ALTONA. Equatoreal. (Prof. Schumacher & Dr. Petersen.)

1848.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″
August 7	14 32 16	6 14 57·2	
	14 46 13	15 0·3	+41 18 46::
10	13 20 43	31 22·3	38 49 0::
11	13 46 40	6 37 14·86	+37 51 50·8

HAMBURG. Equatoreal. (M. Rümker.)

1848.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	No. of Obs.
August 11	13 45 21·2	99 18 27·8	+37 51 42·8	8
13	14 6 41·7	102 21 35·6	35 43 55·4	2
18	14 0 6·0	110 39 45·6	29 5 6·6	10
19	14 36 59·8	112 30 57·6	27 26 10·0	9
22	14 54 54·5	118 17 38·4	22 0 5·1	9
23	15 18 31·4	120 22 6·5	19 57 56·5	5
25	15 26 46·1	124 38 55·6	+15 39 58·1	1

The weather on the 25th was very unfavourable.

The following elements have been computed by M. Sonntag from Altona observations of August 11, 18, and 25, and by M. George Rümker from the Hamburg Observations of August 11, 19, and 23:—

	M. Sonntag.		M. G. Rümker.	
	Per. Pass. Sept. 8·07800, Berlin M.T.		Sept. 8·056005, Greenwich M.T.	
	° ′ ″		° ′ ″	
☊	212 8 35	M. Eq. Aug. 20.	211 34 35·7	App. Eq. Aug. 19.
π	311 4 16		310 34 36·1	
i	85 59 33		84 28 22·0	
Log. *q*....	9·504496		9·50484748	
Motion Retrograde.			Motion Retrograde.	

Comparison of Observations with an Ephemeris by M. George Rümker, founded upon his Elements.

Place of Observn	Augt	Greenw. M.T.	R.A.	Obsd—Cald.	Decl.	Obsd—Cald.
		h m s	° ′ ″	″	° ′ ″	″
Altona	10	12 40 56·6	97 49 59·2::		+38 49 45	−13
Hamburg	11	13 5 27·2	99 18 27·8	− 1·1	37 51 42·0	+ 0·9
Altona		13 6 57·9	18 40·0	+ 5·5	51 50·8	+13·8
Hamburg	13	13 26 47·7	102 21 35·6	+ 6·2	35 43 55·8	− 4·1
Altona	18	13 4 48·0	110 38 33·0	− 4·2	29 5 58·5	+ 5·1
Hamburg.........		13 20 12·0	39 45·6	− 0·2	5 6·6	+13·1
Hamburg G. R.		13 35 30·7	40 45·0	− 8·7	4 6·6	+12·5
Altona		13 52 6·9	42 4·3	− 3·6	2 50·9	+ 1·6
Berlin		14 0 0·1	42 8·5	−34·5	2 19·9	+ 0·4
Hamburg	19	13 57 5·8	112 30 57·6	− 2·6	27 26 10·0	− 1·4
Altona		14 7 15·9	31 40·8	− 5·9		
Altona		14 15 13·7			24 55·8	− 0·4
Berlin		14 17 14·6	32 16·8	−15·3	24 48·6	+ 1·0
Regent's Park...		14 18 31	32 23·0	−15·7	24 39·6	− 2·8
Hamburg, G. R.		14 37 45·0	34 0·3	− 6·2	23 31·9	+ 8·4
Hamburg	22	14 15 0·5	118 17 38·4	−11·2	22 0 5·1	− 2·0
Regent's Park...		14 58 29·0	21 39·6	+11·6	21 56 16·3	−19·1
Hamburg	23	14 38 37·4	120 22 6·5	+ 0·0	19 57 56·5	− 0·0
Altona		14 49 38·9	23 7·7	+ 4·1	56 44·8	−13·5
Hamburg	25	14 46 52·0	124 38 55·6	+ 2·8	+15 39 58·0::	−23·0
Altona		14 58 35·9	40 12·7	+15·0	38 43·9::	−33·8

ENCKE'S COMET.

An ephemeris of Encke's Comet for Greenwich mean midnight has been published by Lieut. Stratford, copies of which have been distributed very freely. Any Fellow of the Society can be supplied with a copy on applying to Mr. Williams.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1848.	Greenwich M.T.	R.A.	Obsd—Cald.	N.P.D.	Obsd—Cald.	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
	h m s	h m s	s	° ′ ″	″			
Sept. 2	13 30 6·5	3 32 16·54	+4·47	55 59 37·8	−28·8	6	5	*a*
4	12 14 39·4	37 6·06	7·51	55 15 21·9	26·3	2	2	*b*
	12 34 8·1	6·69	6·10	14 57·8	31·2	2	2	*c*
	13 36 52·4	15·20	8·02	13 48·9	38·2	6	4	*d*
6	12 32 47·1	3 42 17·53	5·94	54 25 26·7	96·3	3	3	*e*
	12 49 38·8	20·91	+7·43	18·3	−87·3	2	2	*f*

The observations are corrected for parallax, and compared with the ephemeris published by Lieut. Stratford. The authorities for the places of the known stars are the following :—

_a_ = B.A.C. 1132 _b_ = Piazzi, iii. 194 _c_ = H.C. 7016 _f_ = B.A.C. 1228

The assumed apparent R.A. and N.P.D. of the stars *d* and *e*, determined by equatoreal comparisons with *b* and *f* respectively, are,—

	h m s	° ′ ″
d	3 36 21·12	55 15 58·0
e	3 46 55·27	54 25 59·7

The comet had the appearance of an extremely faint nebulosity of very large diameter, and its point of maximum brightness was so difficult to fix upon, that the observations are entitled to very little weight. The magnifying power employed was 120.

South Villa. Equatoreal. (MM. Bishop & Hind.)

1848.	Greenwich M.T. h m s	R.A. h m s	Decl. ° ′ ″
Sept. 3	15 7 49	3 34 53·5	+34 24 27
4	13 49 4	3 37 13·5	+34 46 10

Professor Colla saw the comet at Parma on Sept. 20th, with an excellent telescope of Lerebours, 4 French inches aperture. "It appeared like a faint round nebulosity, the light condensing towards the centre, with traces of scintillation throughout the mass. It was just visible in a telescope by Gilbert of 2·5 inches aperture."

It was seen at Hartwell on Sept. 22d and 25th: "it was so faint as to require a 6-inch object-glass and a practised eye. It appeared in a dull nebulous spot, about 3′ in diameter, rather oblong, a little condensed towards the centre, and shaded off indefinitely at the edge." The corrections to be applied to Lieut. Stratford's ephemeris to satisfy the Hartwell Observations are,—

R.A. + 26ˢ Decl. − 1′ 28″.

Professor Challis' method of correcting Equatoreal Observations for Refraction.

The corrections for refraction in differential equatoreal observations made at the Cambridge Observatory, when the hour-angles for the star of comparison and object compared are the same, are calculated by the formulæ given in p. 188, vol. i. of Bessel's *Astronomische Untersuchungen.* In the triangle of which the angular points are at P the pole of the heavens, Z the zenith of the observer, and S the place of the star; draw from Z a perpendicular ZQ on PS. Let $d'-d$ be the apparent excess of the north polar distance of the object compared, above that of the star of comparison, and Δ the true north polar distance of the latter, or, more correctly, the mean of the north polar distance of the two objects; and let $\mu'-\mu$ be the excess of right ascension given by the difference of times of transit. Then

$$\text{Correction applied to } d'-d = \kappa\,(d'-d)\sec^2(\Delta-PQ)$$

$$\text{Correction applied to } \mu'-\mu = \kappa\,(d'-d)\sec^2(\Delta-PQ)\,.\,\frac{\tan QZ}{15}\,.\,\frac{\cos(2\Delta-PQ)}{\sin^2\Delta}$$

For calculating κ, which depends both on the zenith distance and on the barometer and thermometer readings, the following empirical formula is sufficiently accurate and of ready computation:—

$$\text{Log}\ \kappa = \text{Log}\ k + 0{\cdot}015\ \text{B} + 0{\cdot}001\ (100^\circ - \text{T}),$$

where Log k is Log α'' (in Bessel's Table, pp. 198 and 199 of the work already cited) diminished by the constant 0·4957, B is the barometer reading in English inches, and T is the thermometer reading in degrees of Fahrenheit (Bessel's Log α'' takes account approximately of the variation depending on zenith distance of the factor A in the expression, A tan zen. dist. for the total refraction). To select the proper value of Log k, the argument zenith distance (z) is first obtained by the formula, $\sec z = \sec QZ \sec (\Delta - PQ)$. The calculations are much facilitated by the formation of two tables; one containing the values of P Q, Log sec Q Z, and Log $\frac{\tan QZ}{15}$, for every ten minutes of hour-angle from 0^h to 6^h, whence, by interpolation, and by proper attention to changes of sign, the values may be obtained for any given hour-angle; the other, a table of values of Log k, in which the argument is z, or, which is preferable, Log sec z, the difference between the consecutive logarithms being 0·01.

In an instance in which the apparent difference of north polar distance was 32′·1, the hour-angle $3^h\ 49^m{\cdot}7$, and the zenith distance 82°·3, the corrections calculated by the above approximate formulæ were 18″·12 and $0^s{\cdot}769$. By exact calculation they were found to be 18″·27 and $0^s{\cdot}762$.

When differences of right ascension and north polar distance are measured while the equatoreal is carried by clock-movement (which is sometimes done with the Northumberland equatoreal), it is necessary to compute exactly the total refractions in right ascension and north polar distance of each object, no other method appearing to possess sufficient accuracy.

Extract of a Letter from Mr. Alfred Weld, Director of the Observatory at Stoneyhurst College.

"On September 20, I observed a large spot on the sun with our equatoreal, and found that it consisted of several dark nuclei enveloped in one large penumbra. On the 21st, I made several observations, from which I deduced the following values of the angles subtended by the spot and nucleus:—

	′	″
Greatest diameter of spot	2	41·1
——— nucleus	1	7·2
Equatoreal diameter of spot	2	14·1
——— nucleus	0	49·2
Meridian diameter of spot............	2	14·1

"The spot was distinctly visible to the naked eye before sunset."

By comparisons with δ *Ophiuchi*, *Spica*, and *Antares*, Mr. Weld found the declination of Mr. Hind's changing star to be $-12^\circ\ 37'\ 15''$.

NOTICE OF THE PRINCIPAL ENGLISH OBSERVATORIES.

EXTRACTED FROM OFFICIAL OR DIRECT SOURCES.

It has been thought advisable to insert a brief account of our principal Observatories in the *Monthly Notices*, as, notwithstanding the great liberality with which their publications are distributed, and their observations communicated, many members may not be sufficiently acquainted with their condition. Two British Observatories only, are, properly speaking, public — those of Greenwich and Edinburgh. The Observatory of Oxford was built and is supported by a bequest under Dr. Radcliffe's will: it is under the control of private trustees. The Cambridge Observatory was erected principally by private subscription, and is supported in part by the funds of a professorship founded by Dr. Plume, but mainly out of the University chest. The Radcliffe observer makes an annual report to his trustees; and Visitors appointed by the Cambridge Senate draw up yearly a statement to be laid before that body. Since the appointment of Mr. Airy to the Royal Observatory, a minute Report of all proceedings and changes in that establishment is read to the Board of Visitors at the Annual Visitation in June.

Greenwich.

It has been mentioned in former numbers that the Meridional Instruments at Greenwich are deficient in optical power, and that the Astronomer Royal proposed to replace the Mural Circle and Transit by a single instrument, viz. a Transit Circle, which is to be erected on the site of the present circle-room. In his Report to the Visitors, Mr. Airy says:—

"An object-glass of 8 inches clear aperture and 11 feet 6 inches focal length having been placed in my hands by Mr. Simms, I carefully examined it. I found that it shewed some objects not of the closest class (as ε *Boötis* and ζ *Cancri*) better, I think, than I had seen them before: that it separated η *Coronæ*; that it did not separate γ *Coronæ* (which, having witnessed the difficulty of that star in the great Pulkowa refractor, I was prepared to expect); and that it dispersed light no more than the best object-glasses usually do. At my recommendation, therefore, this object-glass was purchased by the Lords Commissioners of the Admiralty, at the price of 275*l.* I have now to explain the form in which I propose to mount it. No verbal description, probably, can dis-

pense with reference to the model,* and I will therefore confine myself to the leading points. I propose to mount it as a Transit Circle, its Ys bearing solidly on the piers far from their edges, and having no adjustments; the axis carrying two nearly similar circles on the East and West arms, one for clamping, the other for the divisions. I propose that the clamps have no tangent-screw, the bisection being in all cases effected by the micrometer in the field of view of the telescope. I propose that the divisions be illuminated by a single lamp in the prolongation of the axis, without reflectors; and that the microscopes be in a conical surface, passing through one pier, the eye-ends being in a circle of two feet diameter; and that the divisions be cut upon a limb of metal which is so bevelled on the circle that the light of the lamp will be reflected up the microscopes. Several microscopes to be permanently mounted, in positions proper for ascertaining with the utmost exactness the errors of division. Microscopes to be mounted for ascertaining the laws of movement of points on the ends of the pivots. The instrument never to be reversed; but an apparatus to be provided for raising it so far that a collimating telescope firmly fixed on a solid pier on the north side, and one on the south side, can be adjusted on each other; then when the instrument is dropped into its usual place, the error of collimation and the flexure will be determined without reversion, by observation of the two collimators. No spirit-level or equivalent instrument to be used, but the error of level to be determined by observation of the image of the wires by reflexion in a trough of mercury. A parallel-motion apparatus to be used for carrying the trough, and a peculiar arrangement for facilitating the process of cleaning the mercury. In regard to the material, I propose that the whole be made of cast-iron, the axis being in two parts (which enables the founder to make the pivots of hard chilled iron, while the rest is of soft iron), each end of the telescope being in one part, and each of the two circles being cast in one piece. An instrument thus constructed would, probably, be more accurate for right ascensions than the present transit, in so far as the frequent observation of the well-mounted collimators would add to the knowledge of its azimuthal error; and perhaps more accurate for zenith distances than Troughton's Circle, in so far as the circle is in a state of less strain, while its construction possesses greater firmness. But the reasons for recommending it, as is known to the Visitors, are, the power of carrying a larger object-glass, and the enabling one observer to complete the observation of the two elements."

The observations in Polar Distance were made with Jones's Cape Circle, until Troughton's Circle was erected in another apartment, where it is and will be used until the circle-room is rebuilt and

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*** A small model of the proposed transit circle was exhibited at the Visitation in June; and the Astronomer Royal, having obtained the consent of the Government, is proceeding with the construction of the instrument. A full-sized model has been made and approved. The circle room is rebuilding.**

furnished. The Transit will not be disturbed till the new instrument is at work.

The Zenith Tube has been taken down. It was proposed by some of the Visitors that it should be erected in another and less objectionable position than that which it formerly occupied, and a new site was pointed out by the Astronomer Royal. Mr. Airy, however, greatly prefers a different construction, if a continuous series of observations of γ *Draconis* be required. The principle of this construction, which is singularly simple, is thus described by Mr. Airy:—

"Let the micrometer be placed close to the object-glass, the frame of the micrometer being firmly connected with the object-glass cell, and a reflecting eye-piece being used with no material tube passing over the object-glass; and let a basin of quicksilver be placed below the object-glass, but in no mechanical connexion with it, at a distance rather greater than half the focal length of the object-glass, so that an image of the star is formed on the wires after the rays are reflected from the mercury. Such an instrument would at least be free from all uncertainties of twist of plumb-line, viscosity of water, attachment of upper plumb-line microscope, attachment of lower plumb-line microscope, and the observations connected with them; and might be expected, as a result of this extreme simplicity, to give accurate results."

The Astronomer Royal was recommended by the Board of Visitors to take the necessary steps for procuring a Zenith instrument on the principle described, and he has already printed and distributed an account of the construction which he proposes to adopt, with explanatory drawings. There seems scarcely any limit to the power and probable accuracy of such a Zenith tube, and as the mounting is exceedingly cheap and simple, it will most likely come into general use, especially for nice determinations of latitude.

It will be remembered that an Altitude and Azimuth Instrument, made after Mr. Airy's designs by Messrs. Ransome and May, and Messrs. Troughton and Simms, has recently been added to the Royal Observatory, for the express purpose of observing the moon. Mr. Airy says:—

"The Altitude and Azimuth Instrument having now been in use for an entire year, I am able to give some account of its success or failure as a mechanical arrangement. The first subject for remark is the steadiness of support of the upper pivot, which is held in its place, as the Visitors will remember, by a frame of bars whose arrangement in every part is triangular. The steadiness is perfect. In the first observations, the levels were read before and after the telescopic observation, but it was very soon found that this caution was entirely unnecessary. The next point is the steadiness in the position of the horizontal axis of the vertical circle relatively to the vertical revolving-frame, and generally the steadiness of the constants of instrumental errors. For some time the constants were so unsteady as to give me great trouble. Several observations of stars were absolutely rejected. In the month of

July, after careful consideration of the discordances, I came to the conclusion that there was a wandering of the horizontal pivots in their Ys, caused probably by the counterpoises: the counterpoises were therefore diminished by one-third part, and since that time the constants of instrumental error have been steady, and not a single observation has been rejected. The next circumstance which gave me trouble was the uncertainty in the scale-values of some of the long levels. The singular good fortune of having four parallel levels upon the instrument, which are always read, enabled me to compare the proportion of the scale-values in actual use to the scale-values determined before mounting. These were very discordant. I became at length persuaded that this was caused by the very defective construction usually adopted in the mounting of English levels; and in the autumn I applied to the two longest levels the construction with which I had become familiar in Germany and Russia, in which the glass tube of the level is supported in Ys: since that time the levels have been fairly accordant. Another contrivance extensively applied to German levels, namely, the covering by glass shades, has also been applied here. A difficulty which can be surmounted only by constant care has sometimes presented itself, namely, that when the dome is opened very shortly before observation, the changes of readings of the upper and lower levels do not exactly correspond. Lastly, when the best values of instrumental errors of every kind are applied, the accuracy of every part of observation, of calculation and application of instrumental errors, and of tabular calculation, is checked by the determinations of the zero of azimuth. These determinations are sufficiently steady in any one evening, or, perhaps, in groups of several evenings; but they are not steady from time to time, the variation amounting to three or four seconds of arc. Whether this arises from a twist of the brick pier, or from a twist of the piers of the Transit Instrument (the times being obtained from the transit-clock), or from a change in the observer's personal equation, I cannot tell. The substitution of improved meridional instruments for those now in use will enable me to remove one of these conjectural causes.

"I have spoken hitherto solely with respect to the azimuthal observations, in which alone, from the first, I anticipated any difficulty. The zenith distance observations have never given the smallest trouble.

"The accuracy of the results, as estimated by the observation of stars, is somewhat less than that of the Mural Circle, perhaps nearly in the degree which might be expected in circles whose diameter is half that of the Mural Circle.

"For observations with the Altitude and Azimuth Instrument, the following rule is laid down. The moon is to be observed if visible, and the observer is bound to watch if necessary while the moon is above the horizon, and the sun is not more than an hour above the horizon. One azimuth and one altitude are to be observed, and if possible, two azimuths and two altitudes in re-

versed positions of the instrument: and if the night is fine, a low star and a high star are to be observed in azimuth, both in reversed positions of the instrument, and one star in altitude, in reversed positions. Thus a complete set includes ten observations. These rules have been followed carefully during the thirteen lunations intervening between 1847, May 15, and 1848, May 30; and I am now able to give a comparison of the number of days of observation of the moon with the Altitude and Azimuth Instrument and with the Meridional Instruments. With the Altitude and Azimuth Instrument no days are included except both altitudes and azimuths are observed; and with the Meridional Instruments, no days except both right ascensions and polar distances are observed."

"The number of days during the last year in which the moon has been observed at Greenwich are:—

With the Altitude and Azimuth Circle = 203
,, Meridional Instruments = 111

This statement gives only an imperfect idea of the value of the instrument. When the moon passes from 1 to 4 hours before or after the sun, there are 34 observations with the Altitude and Azimuth, and not one with the Transit and Circle.* It is not necessary to point out the immense utility of these results in the lunar theory, or to geography and navigation, which depend on lunar observations for their fundamental determinations.† The results of the observations, as reduced to the state of Apparent Errors of Tables in R.A. and N.P.D., appear very good; perhaps a little, and but a little, inferior to those of the Meridional Instruments.

Throughout the year 1847 the new form of star-reduction proposed by Mr. Airy as a substitute for Bessel's, (see *M. Notices*, vol. vii. p. 189,) has been used, and it has been found convenient. At present the assistants are employed in collecting all the star observations in 1842–1847, for the purpose of forming another grand catalogue reduced to the epoch 1845. The Astronomer Royal proposes to give in this catalogue the star-constants e, f, g, h, l; e', f', g', h', l', and also, for a few years, the day-constants E, F, G, H, L, which are required by his method.

The reduction of Fallow's Cape Observations was commenced some time ago under the direction of the Astronomer Royal. This was interrupted by the work incident to the completion of the lunar reductions, but it will be resumed in a short time.

The ledgers of star-observations and occasional star-catalogues found in Maskelyne's Observations have been fairly written out. Mr. Airy submitted to the Visitors the propriety of printing these

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* The working of this instrument is considered to absorb one assistant and one additional computer.

† When the Lunar Tables are made to satisfy the places of the moon given in the "Reduction of the Greenwich Lunar Observations," and are further corrected by observations made with the Azimuth and Altitude Instrument; well-observed Moon-culminations will not require *corresponding observations*, and occultations will yield trustworthy results *wherever* they may be observed.

reductions, and also suggested whether it might not be advisable to take some steps of calculation with respect to Bradley's Observations anterior to 1750.

In June last, the printing of the volume for 1846 was nearly finished, and the volume for 1847 was commenced.

Edinburgh.

Professor C. P. Smyth has been hitherto engaged in reducing and editing the observations of his lamented predecessor, and in examining and repairing the defects of his instruments and observatory. The meridian buildings are reported to be now in perfect order, and the instruments in a satisfactory state. It will be remembered that Professor Smyth has undertaken to determine the places of stars compared with the small planets and comets in extra-meridian observations, and when he is fully prepared (of which due notice will be given) it will be desirable that he should have early information of the approximate places of those stars, on which accurate and important comparisons depend.

The Astronomer Royal has communicated, and doubtless will continue to communicate, the mean right ascensions of the stars employed at Greenwich, so that the Edinburgh places will harmonise with those of Greenwich; or, as Professor Smyth remarks, "it will not work against but co-operate with Greenwich."

There seems reason to complain of the smoke of the city, but probably this will not very materially injure the great mass of observations. The transit has a noble object-glass 6½ inches aperture, and the Professor proposes to use the circle with illuminated wires on a dark field.

The instability of the Edinburgh transit was suspected by Professor Henderson to arise from the effect of temperature on the foundation. Professor Smyth has traced it to a much simpler cause, a defective original construction of the Ys. He thus describes the construction of the new Ys:—

"They are large slabs of cast-iron, covering the whole area of the top of the pier, and weighing several hundredweight; there are no adjusting-screws, but the sides of the angles in which the pivots rest have been filed away, until the instrument is made to move as nearly in the plane of the meridian as could, perhaps, have been managed with screws. One good result has been certainly proved to have followed, viz. that the reversing of the instrument to obtain the error of collimation does *not* now sensibly throw it out in azimuth, which Professor Henderson used to complain of with the old Ys. Touching the fears that the new Ys might split the stone piers, and the hopes that they might correct the temperature fluctuations, there has not been sufficient time yet to settle that question through the medium of the large transit; it may, however, be considered to be pretty well set at rest by the experiments on the 30-inch transit. This was mounted on a similar huge block of cast iron screwed and cemented down to its pier,

on this it has now been sticking for a year, as firmly but as innocently as could be desired.

"The following is a list of azimuth errors of the 30-inch transit in its cast-iron block, as determined by *all* the transits of *α Ursæ Minoris*, observed on all five wires, during the period which elapsed from the final filing of the Ys to a snapping of two of the wires, which took place, it was supposed, from moisture: the clock star used on each occasion was *θ Ceti*:—

			s
1847.	Nov.	1	— 0·091
		2	— 0·003
		15	— 0·058
		16	— 0·040
		30	+ 0·043
	Dec.	14	+ 0·006
1848.	Jan.	7	+ 0·020
		13	— 0·024

"Now these apparent fluctuations of the Ys in azimuth, which are very small, include the probable error with which each observation may be affected, by reason of the small optical power of the telescope and other matters inseparable from an inferior instrument. Hence they may be considered to be quite insignificant: taking them, however, as they are, and comparing them with the azimuth errors of the large transit in the corresponding period of the years 1841–2, the fluctuations of the large instrument turn out to be *five* times as great as those of the small one; a convincing proof that the cause of the changes hitherto remarked is not in the 'hill on which the observatory is built.' The above list of errors in azimuth may also convince observers that they may themselves rub down unadjustable Ys to limits which will be abundantly within easy calculation (and with transits, too, without micrometer wires).

"The Ys of the large transit having been erected, every screw about the instrument was tried to make sure that it was doing its duty: a number of the smaller ones (which seemed to be made of brass *wire*—drawn brass, not cast brass) were found quite rotten; these were replaced, and a good many new ones introduced about the sliding tubes at the eye end; handles for moving the instrument, and acting *only in the plane of the meridian*, were added; and then, as the line of soldering of the telescope was beginning to shew symptoms of oxidation, the instrument was painted. A nadir pier and mercury trough have been established, and a collimating eye-piece of peculiar construction, which, for perfect vision, seems to leave little to be desired, and reveals almost every affection of the instrument. On account of some of its revelations, the fixed wires have been removed, and five in their place mounted on the micrometer-frame. I propose to examine the errors of collimation and level every night, before and after the observations, as shall be found

necessary, and am now engaged in trying to cure the reversing-carriage of a trick it has got of throwing the instrument to the west during reversal. Collimating lenses, of the full aperture of the object-glass, for marks on the boundary wall, are also being put up, as the old semi-collimating semi-meridian marks are now seldom seen, on account of the increased smoke of the city; and when they are, the 6·5-inch aperture of the transit must be reduced to 2 inches, and the eye-piece pulled out so far as to make the wires very indistinct and unsteady."

Oxford.

The Radcliffe Observer has lately published his seventh annual volume. This consists, like the preceding volumes, chiefly of observations of circumpolar stars contained in Groombridge's Catalogue.

It is not necessary to dwell upon the merits of Groombridge's Catalogue, one of the most laborious tasks ever undertaken by an amateur, as well as one of the most useful. His Transit Circle, though perhaps rather weak as a right ascension instrument, was at the time of its construction, and for many years after, the most perfect instrument in existence for determinations in north polar distance. On this account, and considering that the time elapsed since Groombridge made his observations is sufficient to detect and exhibit proper motions, Mr. Johnson undertook to reobserve the Catalogue with great care, and has now nearly completed the task.

The north polar distances have almost all been re-determined, and a large portion of the right ascensions; there are, however, several gaps, occasioned by the necessity of observing certain circumpolar stars for meridian error, and fundamental stars for clock error. The increased number of well-determined stars will now allow the observer more liberty in this respect, and the blanks are rapidly filling up.

Besides the general advantage of a full standard catalogue of stars within 50° of the north pole, (which by the aid of Groombridge's determinations may be carried forwards for some years,) and the materials thus afforded for investigating precession, proper motion, &c. a special advantage will be found in geodesical operations from this large supply of accurate places for the zenith sector.*

Mr. Johnson expects very soon to receive the Heliometer by Repsold, when his attention will be directed to another department of practical astronomy. Thus limited in time, and having the aid of only one assistant, he has been induced to confine himself in most cases to *two* observations of a star in the same year,

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*** It is proper to remind observers who possess instruments not of the highest class, or who cannot afford the time for deducing fundamental places, that the partial catalogues in the Radcliffe Observations, will supply them abundantly with zone stars, from the pole to 50° of north polar distance, and that the volumes of the Edinburgh Observations will afford a sufficient number of similar stars, for a complete zodiacal catalogue. With these and the Greenwich catalogues there can be no want of a sound base of operations. Professor Argelander has made excellent use of the Radcliffe Observations in his admirable Zone Observations,**

and occasionally to *one*. The star has, however, been observed in *different* years, so that there is a considerable check on errors of computation and on casual fluctuations in the instruments.

Care has generally been taken to note circumstances of interest connected with stars, which have come under observation. Among others, their magnitudes have been watched with much attention. The method adopted has been simply to estimate the apparent magnitudes in reference to *ideal* standards; and pending the discovery of some more accurate photometric measure, Mr. Johnson has instituted an inquiry as to the degree of reliance which may be placed on the method he has pursued. This inquiry has not yet been fully followed out, but the results, as far as they go, are given in the preface to the present volume. From what is there said, it may be inferred that Mr. Johnson would recommend that at every observation of a star, not distinctly visible to the naked eye, an estimate of its magnitude should be noted, unless there is some obvious impediment to a correct determination; and that a mean of such estimates should be taken as the magnitude of any given star, just as the mean of a number of observations in right ascension or north polar distance is considered as the correct right ascension or north polar distance.

Mr. Johnson acknowledges the great services which he has hitherto received in the voluntary revision of his work, first from Mr. Harris, our late assistant-secretary, and latterly from Mr. William Luff, of Oxford. Mr. Luff has most kindly undertaken to read the proof sheets and to revise the additions,* and, from the great care employed, it is hoped few typographical errors escape. When any errors are detected, Mr. Johnson hopes that they will be communicated to him.

The entire expense of printing these Observations is borne by the Radcliffe Trustees. The beautiful typography, and the convenient size of the volumes, enhance their value, and it is gratefully acknowledged that the Trustees distribute them liberally and judiciously.

Cambridge.

The Syndicate appointed to visit the Cambridge Observatory made a Report to the Senate, of which the following is the substance:—

The total number of observations in 1847 were,—

With the Transit,	2540
,, Circle,	2285
,, Northumberland Equatoreal	1400

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* "The process of revision is as follows:—Mr. Luff receives the proof sheet as soon as it comes from the printer. He goes over all the additions, without having the copy by him; he notes all the mistakes he finds; then the proof is collated with the copy and it is seen which are the mistakes of the printer and which of the copy. All being corrected, the proof is returned to the printer. The *revise* is carefully read over again, and no sheet is marked for *press* till it is clear of mistakes."

The observations with the Meridional Instruments are chiefly of the *Sun* (of which there is a very extensive series), *Moon*, *Jupiter*, *Saturn*, *Uranus*, and *Neptune*, with a good series of *Astræa*, *Flora*, and *Iris*. About 300 stars have been also observed.

The Equatoreal observations are for the most part of the minor planets and comets, which could not be seen on the meridian. These are, *Neptune*, *Astræa*, *Hebe*, *Iris*, *Flora*, and the following comets:—*Hind's*, Feb. 6; *Mauvais'* 3d; *Miss Mitchell's; Colla's.*

Professor Challis finds himself so much oppressed with unreduced and unpublished observations, that he has discontinued observations of the sun, moon, and the older planets, since the beginning of this year.* The recently-discovered planets are observed on the meridian and with the Northumberland Equatoreal, and the results communicated to the Royal Astronomical Society and to foreign Astronomers.

The Meridional Observations of 1847 are completely reduced. The Equatoreal Observations are less forward.

The volume for 1843 is nearly ready for publication. It does not contain the Equatoreal Observations, which are reserved for separate publication. Two Appendices are added; one containing so many of the observations made in search of the planet *Neptune* as are required to substantiate the statements given in the Special Report of Dec. 12, 1846; and the other a description of the Northumberland Telescope and Dome, drawn up by the Astronomer Royal.

Liverpool.

A very fine Equatoreal has recently been erected at the Liverpool Observatory. The general form of the instrument has been mentioned in former *Notices*, and it promises, so far as we have heard, to be the most accurate and most convenient instrument of its size now existing. The object-glass is by Merz of Munich, of eight inches aperture; and as it has been approved of by Messrs. Dawes and Lassell, most capable and somewhat fastidious judges, there can be no doubt of its superior excellence. In firmness and steadiness the equatoreal is reported to resemble a meridian instrument. The Hour-Circle is carried, as in the Northumberland telescope, by clock-work, and the right ascension is read off at once by the verniers. The Astronomer Royal, under whose direction the instrument was constructed, has given a perpetual motion to this hour-circle by clock-work moved by a water-wheel, to which a regulator is applied. The variation of the

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* It is perhaps proper to inform those who are not acquainted with the University of Cambridge, that Professor Challis gives lectures during one term on Physics, and that he is largely engaged in the University examinations. His duties as lecturer and examiner *must* be attended to in the *first* place, whatever the Observatory business may be. The University cannot afford to give such a salary as will secure persons competent to carry on the computations without constant superintendence; and when an assistant has obtained the necessary acquirements, he is naturally and properly on the look out for a better place. It is not generally known how much mere heavy labour has been actually performed by the late and present professor.

clock does not exceed 1^s per hour. The declination and hour-circles are sufficiently good to give excellent results when objects are compared beyond the limits of the micrometer, an immense advantage when time is wanting and the weather is uncertain, and in all cases a great comfort, as it secures perfect identification.

We do not know certainly what line of astronomical research Mr. Hartnup will take up. He will do most wisely to follow his own inclination; but such an instrument would be very well employed in observing the planets for instance, especially the smaller planets, when they cannot be observed on the meridian at Greenwich. This would not only complete the series of the Greenwich Observations, but would greatly relieve the Cambridge Observatory, on which this branch of observing has of late pressed heavily.*

Extract of a letter from E. J. Cooper, Esq. Markree Castle.

"So long ago as the discovery of *Astræa*, I had it in contemplation to endeavour to perfect the maps in progress at Berlin, and by means of which that discovery was made, by including, as far as possible, all stars to 12th or 13th mag.; many circumstances combined to oblige me to defer this project. Upon receipt of the Berlin maps, I found that they ranged only 15° on each side of the equator, thus omitting a large portion of the ecliptic. My object being first to complete maps within a few degrees of the ecliptic, I was, of course, forced to adopt other maps in connexion with them. Our mapping proceeded as I had directed during most of the time of my recent absence from home; and when 18^h of right ascension came to the meridian at a convenient hour, Mr. Graham suggested the employment of his square-bar micrometer to enable us to lay down a number of standard points from which subsequently to fill in. I acceded at once to his proposition, and the result has been, for the past month of August, a collection of unpublished stars in the neighbourhood of the ecliptic to the number of 957, observed by me and Mr. Graham. For the reduction to 1850, we united with us my second assistant, Mr. C. Robertson; and by our collective work we have the catalogue ready for publication at this moment, without having lost any opportunity of increasing our stock. Indeed I believe that there are about 600 obtained during the last month. We consider that the probable mean error does not exceed $0^s{\cdot}5$ on these observations; so they approximate quite sufficiently for any maps, or as data for discovery of planetary bodies."

Mr. Maclear has sent from the Cape of Good Hope the mean places of the stars which he compared with Mauvais' comet. See *Mem. Ast. Soc.* vol. xv. p. 242.

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* It is desirable that a semi-public observatory like Liverpool should take a determinate line. We have every reason to admire the zeal and steadiness of our amateur observers, many of whom might be cited as models in these respects; but they ought not to be tied down to a strictness and continuity of research which must often be inconvenient and sometimes impossible.

Mr. Maclear has also forwarded mean places of the stars which Professor Mädler wished to have observed on account of suspected proper motion; along with Observations of *Uranus* and *Neptune* for 1847. These will be noticed in the next number.

Extract of a Letter from the Honourable Edmund Everett, President of the University of Cambridge, U.S.

"Our observatory has been spoken of, I am told, in the Annual Report of the Astronomical Society, as an establishment founded and supported by the state of Massachusetts. This is a mistake. The edifice was built by the university, and the great refractor bought by the proceeds of a subscription on the part of the merchants and friends of science in Boston and the vicinity. A few weeks since, a young gentleman of fortune died, leaving us a bequest of one hundred thousand dollars for the observatory."

A 12-inch altitude and azimuth instrument, an 8-inch sextant, and a theodolite, all by Troughton, the property of the late Admiral Shirreff, are now on sale, and may be seen at the Society's Apartments.

	£	s.	d.
Altitude and Azimuth Instrument....	25	0	0
Sextant....................................	8	8	0
Theodolite	8	8	0

ERRATA.

In the *Monthly Notice*, No. 16 for June 1847, p. 284, *instead* of N.P.D. 102° 24′ 5″·7, which is the *apparent* N.P.D. of H.C. 43446, *read* N.P.D. 102° 24′ 27″·1. This is a different star from that in Bessel's Zones used on May 26.

See pp. 198, 200, for notice of errors respecting *Flora*.

See p. 222, for error respecting Observatory, Cambridge, U.S.

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TO

VOL. VIII. OF THE MONTHLY NOTICES.

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— — 307, *for* sixth satellite of *Saturn*, *read* the most distant satellite.

Vol. VIII. — 36, the sign of the corr. for aberr. in N.P.D. must be changed throughout: it was computed for declination, and not altered.

— — 130, line 10, *for* November, *read* October.

— — 126. The observations of *Flora* at the Durham Observatory are corrected for refraction, but not for parallax.

— — 147, line 4, *for* St. Vidart, *read* St. Vedast.

— — 156, *for* Weisse's Bessel, xvi. 956, *read* xvi. 962.

— — 157, line 1, *for* Piazzi, xvii. 191, *read* xvi. 191, 20 *Ophiuchi*.

The star of about 6 magnitude mentioned just afterwards is H.C. 31188 = Bode 133 Ophiuchi, 5 mag.

— — 161, line 13 from the bottom, *for* 1542, *read* 1548.

See pp. 198, 200, for notice of errors respecting *Flora*.

— p. 222, for error respecting the observatory of Cambridge, U. S.